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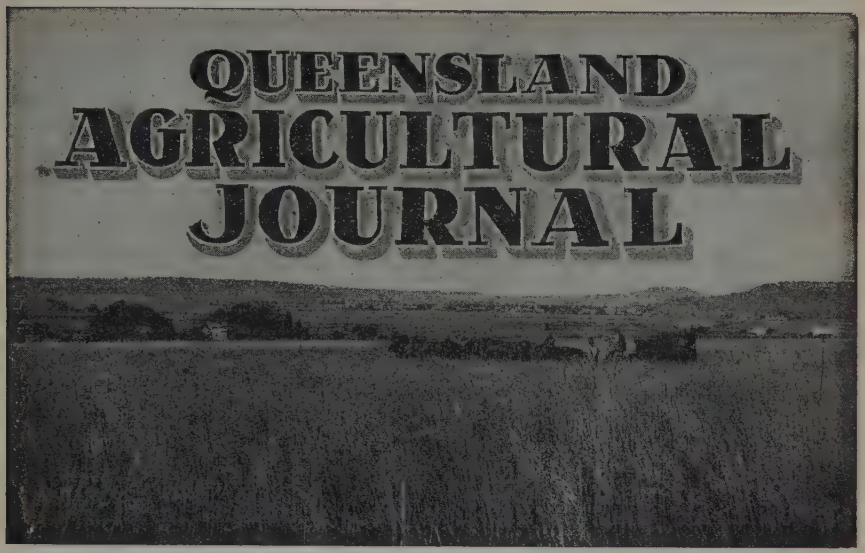
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Event and Comment

Tell the World!

A STRONG plea for Queensland to advertise her products, and to find out exactly what her potential customers want and then give them the very best quality that the State can produce, was made by His Excellency the Governor, Sir Leslie Wilson, when opening the Ipswich Show. "Queenslanders are too modest," said the Governor, "they do not let the world know what they can produce. This is a big fault. It is of vital importance in these days that we should let our potential customers know what we can produce, and then when we have got their orders that we should give them the very best that the State has to offer. To advertise is essential, but it is not right to send our customers something that is just 'good enough.' We must send our customers what they want."

His Excellency said that when he was in the East last year he heard a number of complaints regarding the packing and labelling of Australian goods, especially canned fruits.

"This is entirely due to carelessness," said Sir Leslie. "But it does us harm, as it does not give us a good reputation. I sincerely hope that from now on there will be more careful overseeing, so that this sort of thing cannot happen again."

Continuing, His Excellency said that there were many difficulties in the way of better marketing of Queensland products, but, after all, difficulties were only made to be overcome. Probably no State was faced

with greater marketing difficulties than was Queensland, but in his opinion Queensland had the greatest opportunities of all the States in the Commonwealth.

"It rests with this generation to show the world that Queensland can produce the very best that the world has to offer."

The Ipswich Show was one of the most important in the State, said the Governor, and he congratulated the committee and every person connected with the show on their efforts this year. That despite the dry season the standard of the show was so high spoke volumes for the fertility of the district and the enterprise of the people.

"It is at such shows that one sees the real wealth of Queensland," said Sir Leslie. "At the many country shows which I have visited here I have learned a great deal which I shall be able to use when I return to England."

The Premier's Return—Trade Prospects in Great Britain.

ON arrival at Fremantle from his visit abroad, one of the purposes of which was to attend the sugar conference convened by the British Government, the Premier, Hon. W. Forgan Smith, LL.D., said that the British Government had called the conference with the view of formulating a rationalised scheme of distribution of sugar throughout the Empire and other countries. The conference was not held, however, on account of the contributory countries asking, apparently, too high a quota of the British market. In the course of a press interview the Premier said that the people who were most active in the matter were those who were signatories to the Chadbourne agreement, and they evidently desired to prepare a modern version of the Brussels agreement of 1903. It is just as well, he said, that the conference was not held. Australia had nothing to gain from it. The proposal to hold the conference was based on limitation of output.



Mr. Forgan Smith added: "I investigated the position of the sugar-producing countries of Europe, and it was obvious that they were using sugar to build up their sterling credits in London.

"This was obvious from the fact that in Europe the price of sugar varies from 4d. to 7d. lb. When the conference fell through I, in company with Dr. Earle Page and Mr. T. de Waters, the South African High Commissioner, conferred with the Chancellor of the Exchequer and the Secretary of State for the Dominions, and put up a proposal for a five-year agreement based on the existing rebates in duty. We have an agreement with the British Government that no alterations will take place in the duty without eighteen months' notice. The position now, briefly, is that there is a maintenance of the status quo, and therefore Queensland can export sugar to the British and Canadian markets without limitation. The matter will probably be brought up again at the next Imperial Conference, but I am satisfied that there is no likelihood of any change in policy. If the sugar-producing countries of Europe were to use internally as much sugar per head of the population as, say, Great Britain, so far from there being a surplus of sugar in the world there would be a shortage of 5,000,000 tons annually. The problem is not one of over-production but one of under-consumption."

The Meat Industry.

ON the meat question, which he discussed at some length in Great Britain, the Premier said the Australian quota was likely to be increased because of the recent tariff action. The trouble was that in the past, with drought and such like, Australia had not been able to supply her quota. Regarding Queensland, he said, the meat export trade is having an investigation of marketing methods. Mr. Smith said he would make certain proposals on his return to Queensland. "One thing is quite certain; there is now a future for the frozen meat industry, and we must improve the quality. We must produce a better type."

Prospects for Queensland Butter.

MR. Forgan Smith spoke with emphasis and enthusiasm of direct trade, including direct shipping between Australia and the North of England and Scotland. He said he went into this question very thoroughly, and was convinced that Australia's primary producers had everything to gain by appointing direct representatives in Glasgow, Liverpool, Manchester, and Cardiff. There were wonderful opportunities there, and Scotland was friendly disposed to Queensland and the rest of Australia. Glasgow and Edinburgh were the only two places showing "Empire butter," except when it was a New Zealand product. The New Zealand publicity was better than the Australian in this respect. There was a great prospect of Queensland's butter trade being increased, the trouble at present being the appointment of sub-agents in Manchester from agents in London, with the result that the sub-agents pushed the Danish and Dutch product, for which they obtained a greater commission. Direct trade, he added, would counteract this.

Migration and Markets.

DISCUSSING migration, the Premier said that on this matter he had conferred with the committee established in Great Britain, and had found Great Britain very favourable to the resumption of migration; but he had explained that the subject was linked up with markets, and it was impossible on a large scale with limited markets. He had pointed out that Australia should not be expected to carry the cost of mass migration, and told them very bluntly that it was no good talking migration and at the same time applying a restriction quota on production. Great Britain had no plan, and all discussions were merely exploratory.

He declined to discuss the new tariff, as he had not had an opportunity of studying it, and wanted to be in a position to know the reaction to it in England.

A Commonwealth of British Nations.

ASKED how near Europe was to peace or to war Mr. Forgan Smith said a great deal depended on Great Britain's policy. There was a growing body of public opinion favouring Great Britain co-operating with the Dominions to build a real Commonwealth of Nations as against being the policeman of Europe and the protector of France. Speaking generally, he said, the whole thing was absurd. The League of Nations was like a government without a police force, and the problem was: Could Great Britain afford to be the policeman of Europe and continue being dragged at the coat tails of another country?

Discussing trade prospects generally, the Premier added that everything would depend on reciprocity, and trade could only be conducted on a two-way basis. There was a strong feeling in industrial circles in England, he added, that while Australia was entitled to build up her own industries that that portion of trade which goes to countries which purchase nothing from Australia should go to England.

The Tobacco-growing Industry in the United States of America.

L. F. MANDELSON, B.Sc.Agr., Plant Pathologist.

[*Continued from June,* 1936.]

LIGHT AIR-CURED TOBACCOS.

THE light air-cured types of tobacco are Burley (U.S. Type 31) and Maryland (U.S. Type 32). In both cases the tobacco is stalk-cut when harvested—that is, when the majority of the leaves are mature the entire plant is harvested by cutting the stalk near ground level (Plate 1). The stalks are either split with a knife, from the top towards the butt, and straddled over sticks, or are speared on to sticks.



PLATE 1.

CUTTING MARYLAND TOBACCO.—Light air-cured tobacco is harvested by cutting the stalk near ground level, and the entire plant is air-cured.

In the latter case a movable metal spearhead is placed on to the end of a stick and some half-dozen plants are forced over the point and on to the stick (Plate 2). The leaf is usually cured in large, well-ventilated sheds. At times the sticks are hung on scaffolds in the field (Plate 3) for one to five days in order to wilt the plants prior to curing. Another method is to set the sticks of tobacco in the ground at an angle of 75 degrees with the butts of the plants towards the sun (Plate 4).

Burley.

Burley is one of the most important types of tobacco grown in the United States, and almost a third of the total tobacco area is devoted to it. It is light in colour and body and has exceptional absorbtive capacity for flavouring materials used in the manufacture of plug tobacco. This type has an interesting history, since it developed from

a single plant which was selected in Ohio in 1864 and was given the name "White Burley." It has been further developed to meet changing manufacturing requirements as the demand for chewing tobacco has diminished. In order to produce thinner leaf, "stand-up" types, which may be closely planted, have been developed (Plate 5) and strains resistant to soil diseases have been selected.

Burley tobacco was originally grown mainly in Kentucky, and was then a dark air-cured type used for chewing and smoking purposes. With the great expansion in the cigarette industry and the adoption of



PLATE 2.

SPEARING TOBACCO PLANTS.—The cut plants are forced over a moveable metal spearhead on to a stick in preparation for curing.

this type for cigarette manufacture, the area under crop increased enormously. In 1912 there were 228,000 acres of Burley grown, but by 1931 the area had increased to 528,800 acres and had extended well into Tennessee and neighbouring States.

Deep, well-drained, rich soils are used for growing Burley. Its cultivation is associated with the fertile limestone soils typical of the blue grass country of Kentucky. In that state artificial fertilizers are rarely added to the soil. In the newer areas applications of 500 to



PLATE 3.

WILTING BURLEY TOBACCO.—Burley tobacco in Tennessee hung on scaffolds in the field to wilt prior to being carried to the curing barn.



PLATE 4.

TOBACCO WILTING ON STICKS.—Sticks of speared tobacco wilting in the sun in Maryland. In the background the wilted plants are being loaded on a wagon for removal to the barn.



PLATE 5.

A FIELD OF BURLEY TOBACCO.—Note the "stand-up" character of this strain of Burley which permits close planting for the production of a thin type of leaf.



PLATE 6.

YOUNG BURLEY TOBACCO.—A field of Burley tobacco showing the flat method of cultivation which is practised with this class of tobacco.

800 lb. of a 8-4-4 or 8-3-5 mixture, depending on the soil, have been found profitable. Some growers used 300 to 400 lb. of superphosphate and 8 to 10 tons of stable manure.

In contrast to the seed-beds of the flue-cured areas, those used for Burley are long and narrow. They vary in width from 6 to 12 feet and are covered with cheese-cloth. Soil sterilization by burning over or steaming is recommended.

"Stand-up" varieties such as Judy's Pride, Kelley, and various root rot-resistant strains are becoming increasingly popular and are replacing the older varieties known as Lockwood, Twist Bud, Blue Ribbon, White Burley, and Rainbow.



PLATE 7.

CULTIVATION IMPLEMENTS.—These implements are generally used in Tennessee for cultivating Burley tobacco.

Rows are made 3 feet 6 inches or 3 feet 8 inches apart, and the plants are set 12 inches to 18 inches in the row, depending on the fertility of the soil. They are usually set by hand.

Unlike flue-cured tobacco, Burley is not grown on hills, but is flat-cultivated (Plate 6). Methods of cultivation vary somewhat. In Kentucky the first cultivation is made with a six-tine spring-tooth cultivator and subsequently with a twelve-tooth implement which straddles the rows. About three cultivations are usually made. In Tennessee a fourteen-tooth cultivator is recommended for the first cultivation. A double shovel or three to five-shovelled cultivator (Plate 7) is then used, particularly after packing rain, and weekly shallow cultiation with harrows is practised subsequently.

As indicated above, the crop is stalk-harvested and air-cured. A barn 40 feet wide, 60 feet long, and 16 feet to the eaves is considered large enough for 5 acres. Curing barns vary considerably in construction, and frequently they are very crude (Plates 8 and 9). Where facilities permit (Plate 10) efforts are made to manipulate the ventilation so that the leaf dries out slowly irrespective of the prevailing

weather conditions. During wet weather small fires are usually made in the floor of the barn to reduce humidity and so obviate mould injury known as "house barn" or "pole sweat." When the web and midrib of the leaf has dried thoroughly, curing is complete. During subsequent warm damp weather, when the leaf has "come into order," it is taken down and bulked. It is eventually stripped from the stalks and sorted in to five to seven grades and tied in hands. Burley is marketed in the same fashion as flue-cured tobacco.

In the blue grass country the land is allowed to revert to blue grass sod after one or at most two seasons under tobacco. Elsewhere rotations with wheat, lespedeza, and other crops are practised.



PLATE 8.

A CRUDE BARN FOR AIR-CURING.—In Tennessee Burley tobacco is frequently cured in makeshift barns of various kinds.

Maryland Tobacco.

The unique and valuable type of tobacco known as Maryland is only produced in a very limited area between the Potomac River and Chesapeake Bay in Maryland. Its outstanding characteristics are its excellent burning quality, due to the remarkably high percentage of cell wall-forming materials (cellulose and pectin) which it contains. The leaf is very thin, dry and chaffy, and is rather neutral in aroma. These characteristics make it very useful for blending with other tobaccos to improve the burning quality of a blend without disturbing the aroma and flavour sought. Its chaffy nature tends to "open up" tobaccos, and so makes for the more economical use of tobacco in the manufacture of cigarettes. Since the war its value has been appreciated by the cigarette industry, and there has been an expansion in production. The acreage under crop was increased from 22,000 acres in 1914 to 38,000 acres in 1931. Tobacco has been grown continuously in Maryland for a longer period than in any other area in the United States. Its cultivation dates back to the earliest colonial days, when an important trade was established with European countries. At the



PLATE 9.

A BURLEY TOBACCO CURING BARN.—A type of barn commonly used for air-curing Burley tobacco in Tennessee.

present time almost half the crop is exported. It is grown in much the same way as Burley, on soil which is fairly fertile but rather deficient in humus. Manure gives satisfactory results when available, but in many cases nothing is added to the land, especially after it has been "rested." The use of fertilizers is increasing, and 500 lb. or more of various mixtures such as 8-4-10, 8-3-7, or 8-3-12 may be used. The



PLATE 10.

A MODEL AIR-CURING BARN.—An ideal type of air-curing barn at the Greenville Tobacco Experiment Station, Tennessee. Note the top ventilators and a few side ventilators which are open.

fertilizer is "listed in" with a plough and the ridge is smoothed off with a "drag," or, in many cases, a special implement (Plate 11) known as a "Planter Junior Lister" is used. This implement makes a ridge and has a roller attachment which smoothes it down in one operation. A more recent type is said to also have a fertilizer distributor combined with it. A "drag" with wooden "runners" is frequently used to mark the position where the plants are to be set by drawing it across the field at right angles to the rows. The plants are set by hand, by hand-setter machine, or by a horse-drawn machine midway between the depressions made by the "drag."



PLATE 11.

A "PLANTER JUNIOR LISTER."—A "Planter Junior Lister" in operation in Maryland. This implement "lists" a ridge about the fertilizer drill and smooths off the top of the hill in one operation.

The varieties grown are rather indefinite at present. The United States Department of Agriculture is endeavouring to improve the situation by supplying pure lines of seed, and is selecting strains resistant to black root rot. The tobacco grown is designated by its leaf characteristics as Maryland Broadleaf, Broadleaf Thickset, Narrowleaf, and Narrowleaf Thickset, &c. Maryland Mammoth is a giant variety which developed from a "sport" selection made some twenty-five years ago. It is found satisfactory on the more fertile soil types.

Plants are set in an equidistant fashion usually with about 34 inches between rows and between plants in the row. This arrangement allows plants to be cultivated in two directions. Flat cultivation is practised weekly with a spring-tooth cultivator similar to the Australian type of implement. The soil in Maryland does not appear to erode readily, and, although tobacco is cultivated on rather steep slopes, special precautions are seldom taken.

Maryland tobacco is harvested by cutting similarly to Burley. It is air-cured in large barns, but, unlike other tobaccos, it remains in the barn for close on twelve months before it is sold. During this period

it goes through a natural fermentation process and is then ready for permanent packing. On the other hand, other tobaccos are redried or are specially fermented subsequent to curing.

When weather conditions permit in the late winter the cured plants are taken down and the leaves are stripped and graded into about four grades. The leaf is tied into peculiar large fan-like hands, and is then placed in cylindrical stacks with the butts of the hands towards the centre. After two to four weeks the leaf is bulked with butts towards the outside, in the same manner as flue-cured tobacco, for about six weeks. It is then packed in hogsheads on the farm. A hogshead and a wooden cylinder slightly smaller in diameter are filled with tobacco, and, by means of a screw, all the tobacco is pressed firmly into the hogshead and a lid is affixed. It is then ready for manufacture.



PLATE 12.

ONE SUCKER TOBACCO.—This type of dark air-cured tobacco has coarse narrow leaves with prominent veins and midribs.

The marketing and selling of Maryland tobacco is peculiar and different to that of any other type. It is all sent to Baltimore, where relatively small quantities are continuously being sold by sample throughout the year in the five tobacco markets situated there. Hogsheads as received from the growers are stored in large warehouses. A Government representative takes six samples from each hogshead, and so makes one representative sample hand, which is sealed and appropriately labelled. Each day buyers visit the warehouse and draw for the privilege of making the first examination of lots submitted for sale. Sample hands are made into "bulks" and placed before each buyer, who is given a sheet setting forth details of the samples. During the examination the buyer marks his price on the sheet alongside each lot for which he wishes to bid. The sheet is then placed in a ballot-box. At the end of the day the selling agent compares the sheets, and sells the respective hogsheads to the highest bidder, providing the price is considered high enough. Should bids be equal, the buyer who made the first examination is given the advantage.

DARK AIR-CURED TOBACCOS.

The dark air-cured types comprise Virginia sun-cured (U.S. Type 37), One Sucker (U.S. Type 35), and Green River (U.S. Type 36). They are not very important. Their total acreage is about 53,000 acres, which is approximately only 10 per cent. of that under light air-cured types. These tobaccos are mostly used for the manufacture of chewing tobacco.

Formerly Virginia sun-cured tobacco was hung in the sun for part of the curing process. It is now cured and harvested like Burley, but the name "sun-cured" still persists. Weight rather than colour is the main objective in the cultivation of this tobacco; consequently, it is grown on stiff soils, is set wide apart, and is "topped" low—to about nine leaves. The best results seem to be obtained when it is grown after



PLATE 13.

VIRGINIA FIRE-CURED TOBACCO.—Note the extremely low topping and wide spacing of plants and consequent heavy drooping habit of the leaf.

legumes in rotations. Many flue-cured varieties are grown in the production of this type. At the Bowling Green Experiment Station the best yielding variety appeared to be Kentucky Pryor. The acreage under this type has decreased as a result of changes in consuming habits. There were 15,000 acres under crop in 1913, whereas in 1931 there were only 6,000 acres. It is especially suited for the manufacture of plug chewing tobacco.

The name "One Sucker" tobacco is an allusion to the fact that only one sucker is supposed to develop in the axils of the leaves. One Sucker is a coarse type of tobacco with characteristic narrow leaves (Plate 12) which have obviously large midribs and veins. It is grown mainly in southern Kentucky, as well as in northern Tennessee and southern Indiana. It appears to be restricted to hilly, rough, and heavy soil. It is mainly used for chewing twist tobacco. Some also goes through a special process and is exported to the west coast of Africa, the West Indies, and Central America, where there is a demand for this tobacco by native peoples. As with other dark air-cured types, the production of One Sucker tobacco has declined in recent years.



PLATE 14.

DARK FIRE-CURED TOBACCO.—A field of dark fire-cured tobacco in Tennessee. Note the regular low topping of the plants and the coarse heavy type of growth.

Green River tobacco is grown in western Kentucky. It is apparently very similar in characteristics to Virginia sun-cured, and is handled in a similar manner. However, it was not actually observed during the tour of the United States under discussion.



PLATE 15.

WILTING FIRE-CURED TOBACCO.—Plants which have been harvested by cutting are frequently turned upside down in the field to wilt. Note the labourer straddling wilted plants on a stick for conveyance to the curing barn.



PLATE 16.

CONVEYING FIRE-CURED LEAF TO THE BARN.—After the plants have wilted in the field they are straddled on sticks, placed on a rack on a specially-constructed wagon, and hauled to the curing barn. Note the stalks still in the field.

DARK FIRE-CURED TOBACCOS.

This class of tobacco is cured in barns over open fires. It is characterised by its dark colour, heavy body, and the distinctive flavour which results from the method of curing. Dark fire-cured tobacco is



PLATE 17.

A TYPICAL FIRE-CURING BARN.—A barn in Tennessee for fire-curing. Note the tight construction and supply of firewood.

grown in western Kentucky and Tennessee, as well as in central Virginia. Four distinct types are recognised—viz., U.S. Types 21, 22, 23, and 24. Two of these types—namely, Virginia fire-cured and Eastern fire-cured —were observed in the field. Dark fire-cured tobacco is used for manufacturing snuff, and the better grades for plug wrappers. It is also used to some extent for smoking mixtures and plug fillers and for certain foreign cigars.



PLATE 18.

FIRE-CURING.—Dark fire-cured tobacco being cured in Virginia. Note the smoke issuing from the roof of the barn.

It is grown on heavy silt or clay soils and does well when grown on clover sod land. Fertilizers are not used to any great extent in its production. Amounts varying from 200 lb. to 600 lb. of 8-3-3 mixture are at times applied, or superphosphate alone may be used. Some of the varieties grown are Madole, Black Wax, Mammoth Yellow, and Little Crittendon. To develop a heavy-bodied leaf, plants are spaced widely apart and are topped to eight to twelve leaves (Plate 13). In Virginia the plants are usually set 2 feet 6 inches to 3 feet apart in the rows, with about 3 feet 6 inches between the rows, whereas in Tennessee plants are set at equal distances apart, with about 3 feet 6 inches between the rows and between the plants in the rows. The latter method permits

of cultivation in two directions. The plants are mainly set by hand. In the field leaves are characteristically heavy, dark-green, and gummy, with a drooping habit (Plate 14).

At maturity the plants are split from the top to within a few inches of the ground and cut off. They may then be turned upside down in the field to wilt or straddled on sticks to wilt in the field (Plate 15). Eventually they are loaded on to a wagon which in some cases has a special rack to carry the sticks (Plate 16) and are hauled to the barn (Plate 17). After hanging in the barns for about a week, and when the plants have thoroughly yellowed, numerous small wood fires are made on the earthern floor of the barn. The fires are covered with moist sawdust so as to maintain a slow smouldering fire (Plate 18). Constant care is required to cure the tobacco without injuring the leaf.



PLATE 19.

BARN FOR CIGAR WRAPPER LEAF.—Air-curing barns with horizontal ventilators used in the Connecticut Valley for curing cigar leaf. Note the poles in the foreground used for supporting the cheese-cloth shades under which the crop is grown.

In Tennessee the curing process may extend over one or two months, whereas in Virginia the period is much shorter and often less than two weeks. The Virginian leaf brings a lower price than the other types.

Dark fire-cured tobacco represents about 10 per cent. of the total tobacco acreage in the United States.

CIGAR TOBACCOS.

A cigar consists of three distinct portions—namely, the filler, the binder, and the wrapper—and a special class of leaf is grown for each. The bulk of a cigar consists of filler. Such tobacco must have desirable aroma, flavour, and burning quality, and it is usually a coarse-textured leaf. The filler is bunched into shape with binder leaf, which gives the core of the cigar, shape, and smoothness of surface, and so permits the use of a very thin and incidentally attractive wrapper. Binder leaf must have elasticity and is thinner and of finer texture than filler.

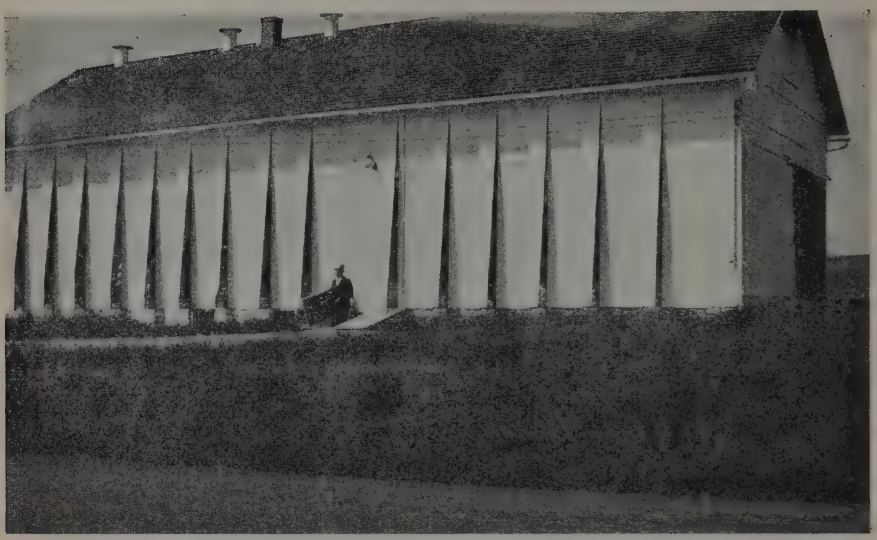


PLATE 20.

AIR-CURING BARN FOR CIGAR TOBACCO.—A barn with vertical ventilators used in Pennsylvania for curing cigar filler tobacco. Note the man ascending from cellar where leaf is handled.

Satisfactory aroma and good burning quality with completeness of combustion are also desirable, and if lacking would tend to spoil an otherwise good cigar. The outside covering or wrapper of a cigar must be of exceptionally fine quality, since it gives appearance to the



PLATE 21.

A "SWISS" AIR-CURING BARN.—The "Swiss" barn on the right is used in some cases in Pennsylvania for cigar tobacco. Note ramp and cellar beneath the floor of the barn. A more usual type of barn is shown on the left.



PLATE 22.

A HUGE SEED-BED.—A large company-owned seed-bed in Florida entirely enclosed with cheese-cloth. Note boiler-house on left for generation of steam for soil sterilization.

finished article. Wrapper leaf is thin, fine-textured, elastic, free from injury, has satisfactory aroma and burn, and, unlike filler and binder leaf, it must also be a desirable colour. The best grades of filler leaf may be used as binder, and binder and wrapper leaf may at times be used for all three purposes. Nevertheless, there is considerable specialisation in the production of these three classes of tobacco, both as regards



PLATE 23.

INSIDE SEED-BED TENT.—A view of the interior of the seed-bed "shade" shown in Plate 22. The plants are watered by a permanent overhead irrigation system.

methods employed in their production and the localities where they are grown. Leaf which is not good enough for cigar manufacture may be used as "scrap-chewing" leaf.

All cigar tobaccos are air-cured. The curing barns are large structures capable of housing several acres of crop. The ventilation system is elaborate. Ventilators are either horizontal or vertical and permit the partial opening-up of the side walls (Plates 19 and 20). Doors at each end of the barn are large enough for a wagon-load of leaf to be taken into the building. In the northern states cellars are frequently constructed beneath the barns for conditioning and handling the leaf (Plates 20 and 21).



PLATE 24.

SUN-GROWN SUMATRA CIGAR TOBACCO.—A field of cigar filler tobacco growing in Florida. In contrast with wrapper leaf, which is grown under shade, this type is grown in the open—*i.e.*, is "sun-grown." It is harvested by "priming" leaf as it matures.

Cigar tobacco soils are relatively rich, in comparison with those found in the flue-curing districts, and are heavily fertilized in many cases. In Connecticut and Florida cigar wrapper is grown on sandy loams. Cigar binder is grown in Wisconsin on sandy loams, light clay loams, and on dark rich loams. Cigar filler in Pennsylvania, Ohio, and New York is produced on loams which are stronger than those used for cigar wrapper and are well adapted for general farming.

Seed-beds in the cigar-growing sections are more elaborate than in flue-cured districts. They are usually about 6 feet wide and are frequently covered with glass-sash. Soil sterilization with steam is a fairly general practice. In Florida a huge seed-bed area entirely enclosed within a cheese-cloth tent was observed (Plates 22 and 23).

The variety Pennsylvania Broadleaf is grown for filler leaf in Pennsylvania. It is given a liberal dressing of about 10 tons of manure per acre and about 500 lb. of a fertilizer mixture, such as 8-3-12, may also be added. In order to produce a heavy-bodied leaf, there is a

tendency for wide spacing and low topping of the plants. The rows are 3 feet to 3 feet 6 inches apart, and plants are set about 24 to 30 inches apart. Sun-grown Sumatra, a filler tobacco produced in Florida (Plate 24) on a lighter type of soil, is given about 1,200 lb. of a mixed fertilizer in addition to manure, and is spaced about 14 inches apart. The plants are topped to twelve to sixteen leaves. In Pennsylvania a common rotation consists of tobacco, wheat, clover, and corn, followed by tobacco. Yields of 1,300 lb. to 2,000 lb. per acre may be obtained. The entire plants are harvested in Pennsylvania by cutting near ground level and spearing on to sticks (Plate 25), whereas in Florida individual leaves are primed as they mature. Length of leaf is of considerable



PLATE 25.

HARVESTING CIGAR TOBACCO.—Cigar filler tobacco being harvested in Pennsylvania. The plants are cut off near ground level and speared on to sticks for curing.

importance for cigar tobaccos, and consequently size is an important factor in grading. The variety Zimmer Spanish is another filler tobacco which is grown in Ohio, but its culture was not observed. Filler is a low-valued leaf, the parity price being about 11 cents.

After the tobacco has been harvested and cured, it is taken to a packer's warehouse, where it is fermented. Huge bulks of several tons are built on the floors and turned every week or so, according to the temperature of the bulk. Since the colour of the final product is of no consequence, higher fermentation temperatures can be used with filler than for wrapper leaf. After some months, when fermentation has been completed, the leaf is stemmed, packed, and despatched to cigar manufacturers.

The varieties Connecticut Valley Broadleaf and Havana Seed are cultivated in the Connecticut Valley for binders. In Pennsylvania the Havana Seed variety is grown for binder tobacco, whereas in Wisconsin this variety and Comstock Spanish have been largely replaced by Big Seed, Havana 38 and various disease-resistant strains.

Tobacco is produced in Wisconsin as a side-line on dairy farms, and artificial fertilizers are used sparingly or not at all, but heavy dressings of manure are applied. Tobacco is generally grown for a couple of years, followed by corn, lucerne, and timothy, or may be grown continuously on the same land. In order to produce a leaf of finer texture than filler, the plants are set closer together in the row, the spacing being 18 to 20 inches in Pennsylvania. The tobacco is harvested by cutting the entire plants and spearing them on to sticks.

Cigar wrapper tobacco is grown under the artificial shade of huge tents or shades in the United States (Plate 26), mainly in order to develop a fine-textured, thin leaf. This method of culture was apparently



PLATE 26.

ERECTING A TOBACCO "SHADE."—A tobacco "shade" under construction in Florida. Cheese-cloth is used for the sides. The roof may be of cheese-cloth, of wooden laths, or of both cloth and laths. Cigar wrapper is grown under shade in order to produce a thin, fine-textured leaf.

discovered by chance in Florida when it was observed that plants growing under the partial shade of trees produced thinner leaves than when grown in the open; consequently, since 1896 various types of shades have been used for the cultivation of this crop. In the Connecticut Valley a very extensive area is grown under cheese-cloth tents. In northern Florida shades may be constructed of cloth, laths or slats, or a combination of cloth and slat. In all cases cloth walls about 8 feet 6 inches high are put up around the shades to protect the tobacco from strong winds and insects. Individual shades may be several acres in extent. The cost of constructing and maintaining shades makes the production of this class of tobacco very expensive, and the rotation of crops a difficult problem. The growing of wrapper tobacco is mainly in the hands of large companies, and consequently a large-scale type of farming is practised. In the Connecticut Valley Cuban varieties are grown for wrapper leaf, whereas in Florida specially developed strains for resistance to the black shank disease, such as No. 301, No. 94, and R.G., are extensively planted.

The soil is very heavily fertilized. Ten to 20 tons of manure is usually applied, and 2,000 lb. or more of mixed fertilizer may be added.



PLATE 27.

"WRAPPING" YOUNG CIGAR TOBACCO.—Young cigar tobacco plants being wrapped around strings tied from the stalks to the roof of the "shade" in order to support and protect the plants.

For thin wrapper leaf, plants are set close together at 10 to 15 inches, in rows about 3 feet 6 inches apart, and are topped high. A practically flat method of cultivation is practised. As soon as the tobacco is established in the field a piece of string is attached to the base of the plant



PLATE 28.

IRRIGATING CIGAR TOBACCO.—Water being led between rows of tobacco during a dry period in Florida. Note the post in the foreground for supporting the roof of the shade. Being in the roadway it is padded to obviate damage to leaf rubbing against it.

and to the roof of the shade (Plate 27). Each week the string is twisted around the stem in order to protect and support the plant. In Florida about 10 per cent. of the shade tobacco-growers have irrigation facilities, but plants are only irrigated during abnormally dry periods when they are suffering from lack of moisture (Plate 28). Tobacco under shade grows to a height of 8 feet or more and yields about 1,000 lb. of leaf per acre. When the leaf is mature, which is ascertained



PLATE 29.

HARVESTING SHADE-GROWN TOBACCO.—Cigar leaf in Florida being harvested by "priming," as with flue-cured tobacco.

by experience rather than by the colour of the leaf, it is harvested by priming (Plate 29), as with flue-cured tobacco. At the termination of the season plants are pulled out of the soil and laid in specially prepared furrows to dry out for a few days (Plate 30).

The harvested leaf is threaded on to string and attached to wooden laths which are hung in the curing barns. When cured, the leaves are tied into a hand with the same piece of string on to which they were threaded. It is then sent to a packer's warehouse for fermentation.

Wrapper tobacco is sweated or fermented in relatively small, neat bulks of about 7,000 lb., and, since colour is an important factor, the process is carried out at a lower temperature than with filler tobacco. The bulk is remade at regular intervals, and when fermentation is complete the leaf is graded, made into hands, and packed in bales for shipment to the manufacturers.



PLATE 30.

UPROOTING TOBACCO.—Cigar plants being uprooted and placed in furrows in Florida. Note the height of the plants. As a result of the crop control plan of the Agricultural Adjustment Administration, the top four leaves must be left on the plant.

The best-quality cigars are made by hand. A relatively recent development has been the manufacture of very cheap cigars by machinery, which are retailed as cheaply as two for 5 cents. Very ingenious machines fill, bind, and wrap cigars, and finally cover them with cellophane with great rapidity. In some factories machinery is also used to strip or remove the midribs from leaf.

[TO BE CONTINUED.]

CONTROL OF INSECT PESTS.

As long as indiscriminate slaughter of the natural controls of insect pests continues, so will we be forced to rely upon unnatural controls, such as arsenical baits and sprays. Is it not feasible that one of the chief factors contributing to the grasshopper plague in the north of Victoria last year was the slaughter of lizards, particularly the blue-tongue and stump-tail varieties which has been going on for generations? Any lout with a pea-rifle will pot them for the fun of it, and it is "awfully" good sport to cut them in two with a stockwhip at full gallop. Not that the losses of lizards by these means amount to much in the balance against grasshoppers; it merely indicates the popular attitude to useful creatures, for which the grasshopper plague is perhaps not an unjust punishment. If farmers as zealously protected insect-eating birds and reptiles as they do their own stock there would be no need to use poison.—"The Australasian."

Mushrooms.

THEIR CULTIVATION, DISEASES AND PESTS.

R. B. MORWOOD, M.Sc., Plant Pathologist, and J. A. WEDDELL, Entomologist.

GREEN plants derive their energy from sunlight and a considerable proportion of their nutriment from the air. Fungi derive the energy required for growth and the whole of their nutriment from organic matter; in the case of the mushroom, from manure in a certain stage of decomposition. The correct preparation of a well-fermented compost, as this is known, is the first essential in mushroom growing. It is made from manure—preferably horse manure—mixed with straw, as much as 70 per cent. of straw being permissible in the mixture.

Preparation of Compost.

In composting, the manure and straw are piled in heaps 4 to 6 ft. high. If at all dry, the mixture is sprinkled as it is being heaped. In a week or ten days the heap is turned by forking over, breaking up any clods and watering any dry portions. The outside of the old pile is brought to the centre of the new heap. The turning is repeated two or three times at intervals of about five days. The temperature of the heap should rise to about 150 deg. Fahr. and gradually drop. A well-made compost finally becomes a uniform brown colour with an even texture, being moist but not wet. When squeezed, it will moisten the hand without oozing excess water and will retain the shape to which it is moulded. When the temperature has fallen to 100 deg. Fahr. the compost is placed in beds about 4 ft. wide and 10 inches deep, which are usually enclosed in a hardwood or galvanised-iron frame. One ton of compost will fill from 30 to 40 square feet of bed.

Conditions for Growth.

Mushroom beds are located in a cellar, cave, specially constructed mushroom house, or other cool enclosed situation. "Under the house," with suitable enclosing, is popular locally. The chief requirements of the mushroom house is that the temperature may be maintained between 45 deg. Fahr. and 70 deg. Fahr., and the humidity at from 80 to 90 per cent. A certain amount of ventilation is necessary, but, except in tightly constructed houses, no special provision for this is needed. The temperature requirements are a somewhat exacting factor. In cold climates houses are provided with heaters, and in warmer parts some progressive growers even provide cooling systems for summer production. Local growers are advised to choose the coolest possible situation for mushroom beds. Towards the upper limit of the temperature range (60 deg.-70 deg. Fahr.) mushrooms will be produced for a short time only, and if the temperature rises above this for a few days then serious harm is done to the beds. At the lower temperatures production continues for several months. A further fall below 45 deg. Fahr. only slows up production for the time being.

The humidity is maintained by the exclusion of draughts, by light watering of the beds, and, when necessary, by sprinkling of the floors and walls of the mushroom house with water. Mushroom houses are usually dark on account of the amount of enclosing carried out, but when other conditions are suitable mushrooms will grow equally well in

the light. Well-built houses have the ventilation openings screened and are so constructed that they may be tightly closed for fumigation for the eradication of pests and diseases.

Preparation of Bed.

When the compost is placed in the bed it is firmed down and, if necessary, lightly watered. The temperature is then allowed to drop to 75 deg. Fahr., when the spawn is added. One pint of spawn is sufficient for 20 square feet of bed, the spawn being broken up into pieces about the size of a walnut and inserted at intervals approximately 10 inches each way. About one week later the bed is covered with an inch of friable soil and lightly tamped. Soil from below the surface, free from weed seeds, &c., is to be preferred. An acid soil is detrimental unless the acidity is corrected with lime. It is kept moist by light watering, excess water being as detrimental as drying out.

Mushroom spawn can be obtained as brick spawn or pure culture spawn. The former consists of blocks of compost penetrated by strands of the fungus and then dried. The latter differs in that sterilised compost is placed in bottles and seeded with a culture of mushroom obtained from spores or tissue with precautions against contamination with any other organism. It is consequently more reliable.

Cropping.

Strands of mycelium (fungus threads) from the spawn ramify through the bed and send up their fructifications—the mushrooms—in from four to six weeks. Given suitable conditions, beds continue to produce for several months, after which the spent compost is useful as garden manure.

Mushrooms are plucked rather than cut from the beds, pulling with a twisting action being most suitable. Any stub of the mushroom stalk left in the bed is carefully removed to prevent its becoming a centre of rot, and the soil is pressed into the hole left. The stalks are cut from the caps before packing, and all mushroom refuse is carefully removed from the vicinity of the beds and destroyed.

MUSHROOM DISEASES.

Mushrooms, like other cultivated crops, are subject to the attack of diseases. These, when first encountered, cause little loss, but they are liable to accumulate when mushrooms are grown over a long period in the same place without special precautions.

Bubbles.

The disease, bubbles, which transforms the developing mushroom into a distorted putrid mass, is the most destructive. It is caused by a parasitic fungus, *Mycogone perniciosa*. The parasite may gain entrance to the beds from a previously infected bed in the same house, with the casing soil, or in contaminated brick spawn. Spores of the disease may also be blown in from infected surroundings, but they do not come with the compost, as this ferments at a temperature sufficient to kill the spores. Measures are taken to deal with the disease when it is present in a district. Diseased material is removed from the bed and destroyed. After the spent compost is removed when the crop is finished, all fittings are sterilised with a solution of one pint of formalin to fifteen gallons of

water. Houses are at times fumigated with sulphur fumes or formaldehyde gas after the compost has been placed in the beds but before they are spawned. When the house can be made gas-tight, this is more effective. For sulphur fumigation 2 lb. are burned for every thousand cubic feet of air space. The sulphur is lit with a kerosene soaked wick, a deep tin being used to hold the material in order to avoid fire risk from spattering of burning sulphur. The house is tightly closed as soon as the sulphur is lit. Great care is taken in the selection of casing soil to see that it has not been contaminated with mushroom refuse or it is sterilised by heat or formalin. The environs of the house are kept clear of old compost, &c., and the formalin solution is freely used. The use of pure culture spawn obviates the risk of entry of bubbles with the planting material.

Other Diseases.

Bacterial spot is a disease which follows excess watering—particularly prolonged wetting of the mushroom caps. Green mould is liable to develop in patches around old mushroom tissue left in the bed if the picking has been carried out somewhat carelessly. Plaster mould may occupy a mushroom bed to the exclusion of the crop planted. It is usually introduced with contaminated brick spawn and is accentuated if the manure is wet and soggy at the time of filling the beds.

It will be seen that the precautions to be observed for the control of diseases of the mushroom consist in the maintenance of sanitary conditions around the mushroom house, the observance of all cultural details, the use of pure culture spawn, care in the selection of casing soil, and thorough sterilisation after any outbreak occurs.

MUSHROOM PESTS.

Mushrooms are subject to the attacks of a number of insects and related organisms, and where commercial culture is contemplated, it is both possible and advisable to plan the mushroom house or cellar in such a way as to minimise the risk of infestation and also to make control measures possible. The pests that have in recent years caused injury to mushrooms in the Brisbane district include mushroom maggots, woodlice, and slugs. As, however, in addition, mushroom mites and springtails are elsewhere serious pests, all five will be briefly dealt with.

Mushroom Maggots.

Mushroom maggots are the tiny creamy white larvæ of small blackish flies, usually referred to as fungus gnats. These insects breed very rapidly, particularly at the higher temperatures. The eggs, of which there are large numbers, are laid either on the mushrooms or on the bed itself, and the maggots, hatching in two or three days, tunnel into the mushrooms and cause a breakdown of the tissues. The adult flies may also convey mites and mushroom disease infection. The best method of control in commercial production is prevention by excluding the insects. The mushroom house should be well constructed and all ventilation channels should be screened against the adult flies with very fine wire gauze. It should also be possible to tightly shutter all openings to permit of fumigation. If the compost has been properly prepared, and fermentation has carried it to a high temperature, then there is little danger of the maggots being conveyed in it. Should the compost not be well prepared, and infestation suspected or observed, then the whole may be fumigated prior to spawning, either with carbon bisulphide used at a

dosage of 2 to 4 lb. per 1,000 cubic feet in the mushroom house, or by the use of sulphur fumes from burning sulphur as recommended for disease control. Carbon bisulphide should be handled with care as it is inflammable and explosive; full directions for its use are given in a leaflet on fumigation. Dusting pyrethrum powder over infested beds is also said to be beneficial, while the maintenance of the mushroom house at a temperature of about 55 deg. Fahr. or less will markedly reduce the breeding activity of the insect.

Mushroom Mites.

Mushroom mites are very similar to cheese mites, to which they are closely related. Like them, they are minute, whitish, and very prolific. They may infest a mushroom house through the transportation of migratory individuals in infested compost or in spawn from an infested house. The mites may damage all stages of mushroom growth—mycelium and young mushrooms, or, hidden in the gill folds, cause breakdown of more mature mushrooms. Mites are very difficult to deal with when once infesting a mushroom house. The infested compost should be carefully removed to a distance and preferably destroyed by burning. All adjacent timber work and floors should be thoroughly scalded and liberally dressed with a solution of creosote or carbolic acid.

Woodlice.

Woodlice are flattish oval organisms, greyish brown in colour, and having seven pairs of legs. They usually shelter in crevices in timber and other dark, damp situations and they feed at night on decaying vegetable matter, moulds, and fungi. Woodlice damage mushrooms by feeding on the fruiting bodies, thus spoiling the appearance of the product. Small infestations may be controlled by hand collecting at night. Alternatively, the poison bran bait, ordinarily recommended for cutworm control, may be sprinkled thinly, encircling the beds and about any situations in which woodlice are suspected, care always being taken to ensure that the poison bait does not come into contact with the growing mushrooms.

Slugs.

Slugs may also feed on the maturing mushrooms, eating unsightly holes in them. Control of the slugs may be obtained by the same baiting method as recommended for woodlice.

Springtails.

Springtails that have elsewhere been recorded on mushrooms are minute brown or black insects which, when disturbed, leap vigorously after the manner of fleas. They feed on the compost materials, and may cause damage either by feeding on the mycelium or by devouring the mushrooms. Large numbers may congregate on a mushroom and eat holes in the gills. Correct preparation of the compost will largely eliminate any springtails that may be present in the materials. Should infestation become evident prior to the appearance of the mushrooms, then fumigation with burning sulphur as previously mentioned should greatly reduce the numbers. The maintenance of the mushrooms at a temperature of 55 deg. Fahr. or less will slow up the breeding rate of the insects.

The Distribution of the Gastro-Intestinal Parasites of Sheep in Queensland.*

F. H. S. ROBERTS, D.Sc., Animal Health Station, Yeerongpilly.

A CONSIDERATION of the prevalence of the gastro-intestinal parasites of sheep throughout Queensland, in so far as can be ascertained by the presence or absence of marked helminthiasis, shows that of all the climatic factors which might be responsible for any variation in incidence that of precipitation appears predominant.

In the South, on the Darling Downs (Toowoomba, Stanthorpe, Miles, Goondiwindi), the mean annual rainfall is high—25 inches to 36 inches—and is well distributed throughout the year. Unimproved pastures in this district may carry as high as a sheep per acre, and as a consequence of this high, well distributed rainfall, with its associated heavy stocking, the Darling Downs is probably more heavily infested than any other district in the State. In the South-West (Charleville, Cunnamulla), the summer rainfall is lower and the winter rains not so well distributed. In the Charleville district (19 inches) outbreaks are infrequent, whilst at Cunnamulla, the very scanty annual rainfall of about 14 inches is responsible for one of the most worm-free areas in the State.

In the Central-West (Emerald, Barcaldine), the summer rains are well distributed and useful autumn and winter rains occur. The mean annual falls vary from 20 to 27 inches. In the higher rainfall areas (Emerald, Clermont, Springsure), helminthiasis is extremely common, and in its intensity approaches that of the Darling Downs. The disease does not appear to occur west of Barcaldine, in which area the annual rainfall is about 20 inches. In the North-West (Hughenden-Cloncurry) and far West (Longreach), the rainfall is practically limited to the summer months, and here, although falls as high as 19 inches per annum are received, no cases of helminthiasis endemic to these districts have yet been observed. The mean monthly and annual rainfalls of the various sheep districts are given in Table 1.

TABLE I.

Locality.	Rainfall in Points.												
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total.
Brisbane	651	625	571	375	283	285	223	204	200	256	368	486	4,527
Toowoomba ..	506	451	381	254	219	252	203	169	214	257	319	431	3,656
Stanthorpe	359	328	270	172	185	196	203	182	228	255	269	351	2,998
Goondiwindi ..	296	264	259	157	174	187	175	128	151	171	221	295	2,478
Mitchell	304	323	291	150	134	175	136	99	127	148	205	282	2,374
Charleville	245	278	234	143	128	137	119	76	86	126	160	243	1,975
Cunnamulla	133	215	142	114	109	120	89	70	86	90	98	160	1,426
Emerald . ..	443	350	289	148	111	179	97	92	119	144	182	357	2,511
Springsure	427	409	298	161	127	180	106	108	126	163	203	327	2,635
Blackall	294	343	263	142	145	121	102	66	83	139	147	260	2,105
Barcaldine	328	302	250	154	124	111	89	55	70	111	128	244	1,972
Longreach	227	377	234	101	89	81	70	30	61	86	104	193	1,653
Winton	343	306	206	71	58	71	62	24	45	74	127	206	1,593
Hughenden ..	483	349	213	117	62	82	40	33	46	87	127	287	1,926
Cloncurry	459	432	242	72	36	44	34	18	33	47	126	319	1,862

* The various localities mentioned in this report will be found in the accompanying map of Queensland.

Prior to about 1932 the only species of gastro-intestinal helminths considered to be of any economic importance among sheep in Queensland were the stomach worm, *Haemonchus contortus*, the nodule worm, *Oesophagostomum columbianum*, and possibly the tapeworm *Moniezia expansa*. Various species of the small Trichostrongyles were known to be present, but up till then had been seen only in small to moderate numbers. At about this time serious outbreaks of trichostrongylosis occurred on the Darling Downs, since when this disease has become very prevalent and is spreading north and west. The distribution of practically all these gastro-intestinal species was unknown except from information secured when outbreaks were investigated. From about 1933, therefore, an attempt was made to obtain more accurate data regarding both the prevalence and distribution of the various species throughout the State, as it was considered that only in this way could some idea be secured of the economic importance of each species. This survey has been very materially assisted by an examination of viscera sent into the laboratory from all parts of the sheep areas. These sets of viscera were taken mainly from lambs and weaners, though in a few cases, where young sheep were not available, viscera from older animals were examined. In all cases, irrespective of age, the viscera specimens were taken from animals which had spent the whole of their life in the district they represented.

The frequency with which the respective helminths occurred in the 122 viscera specimens examined is given in Table 2.

The Twisted Stomach Worm (Haemonchus contortus).

This species is apparently the most frequent and most widespread helminth occurring in the gastro-intestinal tract of sheep in Queensland. It is most pathogenic on the Darling Downs and in the Central-West, whilst mortalities due to its presence may occur as far west as Charleville and Barcaldine. Odd specimens were taken from sheep from Longreach, Hughenden, Winton, and Cloncurry.

The distribution of *Haemonchus contortus* throughout Australia and other parts of the world shows it to be primarily a summer rainfall species. In winter rainfall areas such as England, New Zealand, and Southern Australia it is a parasite of comparatively little importance, whilst in South Africa and the summer rainfall areas of Australia it reaches decidedly pathogenic proportions.

Its distribution in Queensland shows that it attains its highest development in those areas in receipt of an annual rainfall of about 24 inches and more, more especially if the rainfall is distributed throughout the year. Apparently in the far West and North-West, the long dry periods, high summer temperatures, and rapid rate of evaporation prevent the species from becoming abundant, though its occurrence in small numbers in sheep in these areas indicates a high resistance to these adverse climatic conditions.

The Lesser Stomach Worm (Ostertagia spp.).

Three species of this genus have been found in sheep, namely *O. circumcincta*, *O. trifurcata*, and *O. ostertagi*. This latter species, which is normally found in cattle, was collected on two occasions in association with *O. circumcincta* from sheep from the Darling Downs. It is very prevalent in cattle on the South and North Coast, and very

TABLE II.

No. of Sheep Examined.	Per Cent. Positive for Helminths.	Per Cent. Positive For.	
122	94·8	*H. contortus.*	70·2
		O. circumcincta.	18·6
		O. trifurcata.	3
		O. asterangi.	1·6
		T. axei.	33
		T. colubriformis.	66·2
		T. vitrinus.	28·4
		T. rugatus.	6·5
		T. probolurus.	6·5
		T. falculatus.	8·
		C. curticei.	16·1
		C. oncophora.	6·5
		C. punctata.	0
		C. pectinata.	10·8
		N. filicollis.	33·5
		N. spathiger.	32
		B. trigonocephalum.	8·
		H. gigardi.	9·2
		M. expansa.	25·4
		O. columbianum.	51·2
		O. venulosum.	2·5
		C. ovina.	:
		T. ovis.	25

heavy infestations have been observed. As many as 12,000 specimens, for example, have been taken from young calves.

O. circumcincta was taken from sheep in the South, South-West, and Central-West. It was most frequent and most prevalent in sheep from the Stanthorpe district, though the numbers seen in any sheep did not exceed 1,250. Throughout the rest of the Darling Downs it was present in practically every sheep examined, but only in small to moderate numbers. The species is apparently rare in the South-West (Charleville), and in the Central-West it appears to be confined to the eastern areas only (Emerald, Springsure). It was not collected from sheep in any of the other portions of the State.

The third species, *O. trifurcata,* was comparatively rare. It has been seen only on the Darling Downs, and as many as 600 have been taken from a single animal from this district.

Very little is known regarding the distribution of *O. trifurcata,* but *O. circumcinata* appears to reach its highest development in winter rainfall areas. It is a very important parasite in England and on the highlands of Kenya. It is apparently of little importance in Queensland, though it may on occasions possibly become sufficiently numerous in sheep in the Stanthorpe district to be pathogenic.

Hair Worms (Trichostrongylus spp.).

Of the six species of this genus recorded from Queensland, *T. colubriformis* is undoubtedly the most common and most widely distributed, being almost as frequent and widespread as *H. contortus. T. colubriformis* appears to reach its highest development on the Darling Downs and adjoining portions of the neighbouring districts, where during the past few years it has been responsible for serious outbreaks of trichostrongylosis. In the South-West (Charleville), the species is very prevalent and as many as 4,500 specimens have been collected from a lamb. In the Central-West, numbers of 3,000 to 5,000 have been seen in sheep from between Emerald and Barcaldine. No cases of trichostrongylosis have yet been reported from either the South-West or Central-West, but the frequency and abundance with which *T. colubriformis* was observed in this survey in sheep from these areas, indicate that this species may at times reach pathogenic proportions. At Hughenden and Winton, the maximum number of *T. colubriformis* observed in any animal was approximately 200, whilst at Cloncurry and Longreach only odd numbers were taken.

The remaining species do not appear to be of any economic importance. *T. vitrinus* was very frequent on the Darling Downs, especially in the southern portion of this district, but only small numbers have been seen. This species is apparently widely distributed, as it has also been taken at Charleville, Barcaldine, and Hughenden. The third species, *T. axei,* was most prevalent in sheep from Charleville, practically every animal examined from this locality being infested, though the maximum number collected from any one animal was only 850. It was frequently seen on the Darling Downs, though only in very small numbers, and has also been taken from sheep in the Central-West as far out as Jericho. The three remaining species were of rare occurrence. Both *T. rugatus* and *T. probolurus* were collected from sheep from the Darling Downs and Charleville, whilst *T. falculatus* has been seen on one occasion only, one male occurring with a very heavy infestation of *T. colubriformis* in a lamb from Dalby.

The prevailing species of Trichostrongylus in northern New South Wales appears to be *T. colubriformis,* whilst in southern New South Wales *T. vitrinus* becomes very numerous. In Tasmania, heavy infestations of *T. colubriformis, T. vitrinus,* and *T. rugatus* may occur. In England, *T. axei* and *T. vitrinus* are most frequent, though *T. colubriformis* is also very common. In South Africa, trichostrongylosis is said

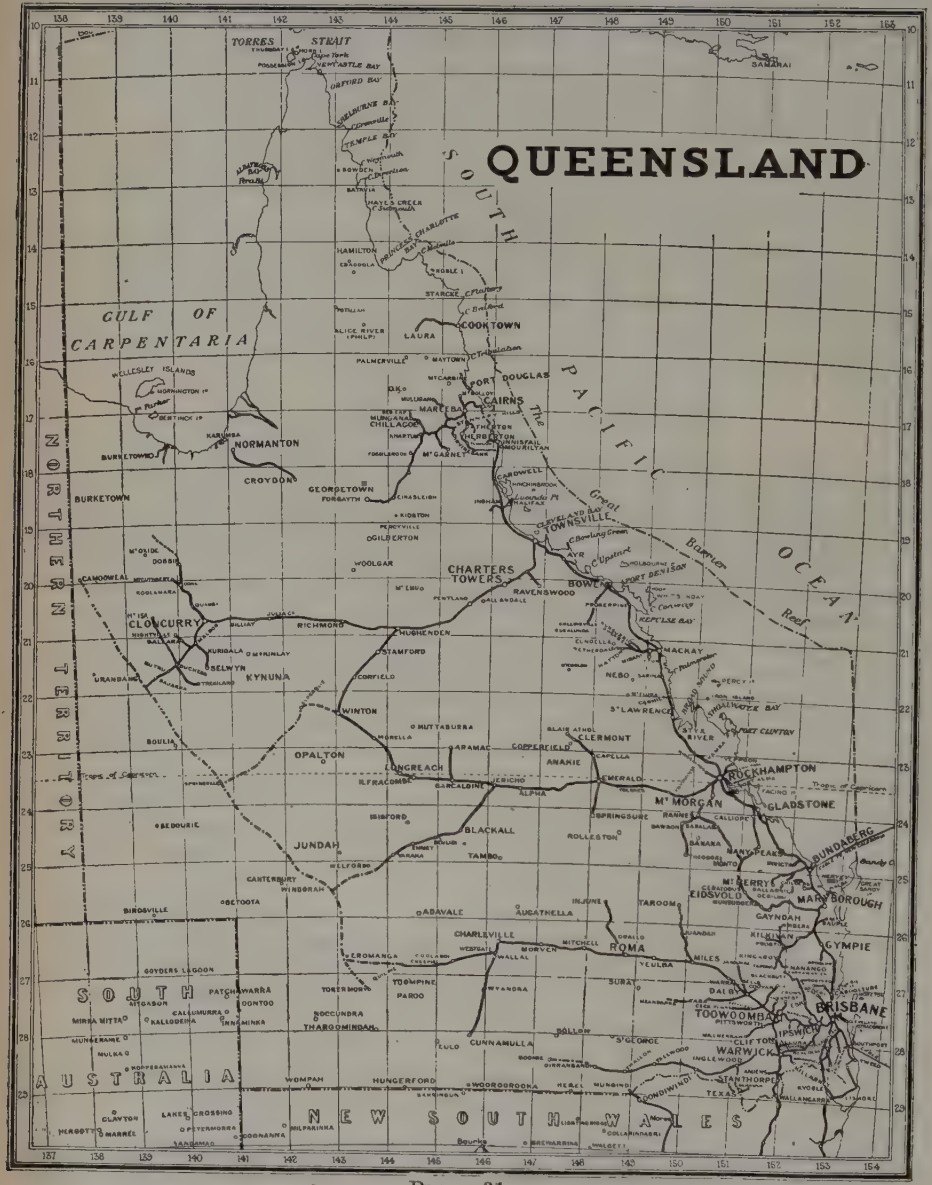


PLATE 31.

to be associated chiefly with *T. colubriformis* and *T. rugatus.* Apparently *T. axei* and *T. vitrinus* reach their highest development in temperate climates, whilst the distribution of *T. colubriformis* indicates a very resistant and very adaptable free living life cycle.

Nothing is known regarding the factors influencing the distribution of *T. probolurus* or *T. falculatus*, except that both species are rare in New South Wales and Queensland. The fact that *T. rugatus* may build up heavy infestations both in Tasmania and South Africa indicates highly resistant preparasitic stages similar to that of *T. colubriformis*.

Cooperia spp.

Of the four species of Cooperia encountered, the only one to be seen in any numbers was *C. curticei*. Two lambs reared at Yeerongpilly, Brisbane, yielded 5,000 and 8,500 specimens, respectively, whilst in two lambs from Caboolture as many as 3,000 to 4,000 specimens were seen. Both these localities are, however, outside of the true sheep-raising country. On the Darling Downs, *C. curticei* was frequent, but the highest number collected was only 236. *C. oncophora* was comparatively rare, and like *C. curticei* appears confined to the south of the State. Both *C. punctata* and *C. pectinata* have apparently a wide distribution, and have been taken from sheep in small numbers at Charleville, Longreach, and Cloncurry. Both these species are very common in cattle in the coastal areas, and up to 11,500 specimens have been collected from a calf.

Climatic conditions in Queensland do not appear to be very favourable to the development of *C. curticei* and *C. oncophora* except in the South-East, where the rainfall is very high and well distributed. Both species are apparently best suited by a temperate climate in so far as can be judged by their distribution throughout the world. In Kenya, for example, they are confined to the highlands. The two other species, *C. punctata* and *C. pectinata*, have a tropical and sub-tropical distribution, though their presence in the far West and North-West of this State indicates a high resistance to high temperatures and long dry periods.

The Thread-necked Trichostrongyles (Nematodirus spp.).

This genus was practically confined to the South and South-West, though a few specimens were taken in the higher rainfall areas of the Central-West. Only small to moderate numbers were encountered. On the Darling Downs, *N. filicollis* was most numerous, but towards Charleville *N. spathiger* appeared in increasing numbers. *Nematodirus spp.* occurs principally in temporate climates, and is a parasite of some importance in England, New Zealand, and probably Southern Australia. *N. spathiger* appears more capable of existing in drier climates than *N. filicollis*, as it is the common species in South Africa.

The Hookworm (Bunostomum trigonocephalum).

The sheep hookworm has not been seen in any of the true sheep areas, but the opportunity is taken here to record its presence in a lamb from Caboolture on the North Coast. As eighteen specimens were taken from this lamb, the parasite is regarded as being very prevalent in this locality.

In New South Wales the species is confined to the Hunter River Valley, and has recently been recorded from the southern areas of West Australia.

The species occurring in cattle, *B. phlebotomum*, is very abundant in the coastal areas, especially in the tropical portions, of Queensland.

Moniezia expansa.

The occurrence of *Moniezia expansa* in sheep from Cloncurry and Longreach indicates that the species has a very wide distribution and a high resistance to high temperatures and dryness. The species is, however, most prevalent in the higher rainfall areas, namely the South and Central-West.

The second species of this genus which has been recorded from sheep in other countries, namely *M. benedeni,* has so far been seen only in calves in the coastal areas.

Helictometra giardi.

This second species occurring in sheep in Queensland is not as common as *M. expansa,* but appears to have a similar distribution throughout the State.

Large Bowel Worms.

Both *Oesophagostomum columbianum* and *O. venulosum* have been seen. The latter species has been taken on three occasions only, at Dirrandandi and Goondiwindi, both localities being in the south-west corner of the Darling Downs.

O. columbianum is very widely distributed and reaches its highest development on the Darling Downs and in the higher rainfall areas of the Central-West. As it occurred in moderate numbers in sheep from Charleville and Barcaldine, its western distribution probably extends further than these localities, though it did not occur in sheep from Longreach or from any of the North-West areas.

O. columbianum has apparently the same climatic distribution as *H. contortus,* but its absence in the far West and North-West indicates that the free living stages are not so resistant to high temperatures and prolonged dry conditions.

The occurrence of *O. venulosum* in the south-western section of the Darling Downs is very interesting, as this species is essentially a parasite of temperate climates. In one lamb from Goondiwindi as many as 65 specimens were present, so it is probable that the incidence of *O. venulosum* in this district is greater than that recorded in this survey.

Chabertia ovina was not encountered in sheep from any of the districts surveyed, but a personal communication from the McMaster Animal Health Laboratory, Sydney, states that the species has been taken by them in a lamb from Dirranbandi.

The Whip Worm (Trichuris ovis).

One would expect this helminth with its resistant egg stage to be very prevalent and widely distributed. It was present, however, only in 25 per cent. of the animals examined, and the maximum number seen in any animal did not exceed 30. The species was absent in all sheep examined from the far West and North-West.

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STAYING POSTS OVER A SLIP.

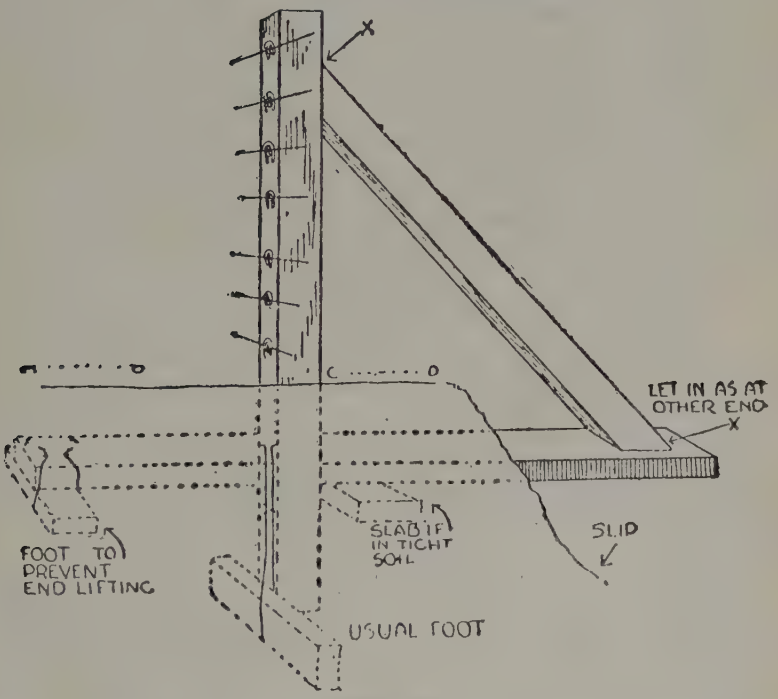


PLATE 32.

Many fencers are confronted with problems which often appear to have no solution. Here is an example of a suspended stay where the ground has fallen away. To take the fence lower down the hill is impossible. To bring it up nearer the road is also impossible. The distance between C and D is too narrow for a stay. The illustration offers a solution.—The "Cane Growers' Weekly" (Mackay).

Studies on the Biology and Control of the Large Roundworm of Fowls, Ascaridia galli (Schrank 1788) Freeborn 1923.

By F. H. S. ROBERTS, D.Sc., Animal Health Station, Yeerongpilly.

PART I.

1. INTRODUCTION.

THE nematode with which these investigations are concerned is a large species of the genus Ascaridia parasitic in the small intestine of the domestic fowl. The taxonomy of this species has in the past been somewhat confused as it was considered that there were two distinct species of large roundworms of this genus parasitic in this host—namely, *A. perspicillum* (Rudolphi 1803), to which Freeborn referred the name *A. galli* in 1923, and *A. lineata* (Schneider 1866). Schwartz[94] considered the species present in the United States, the Philippine Islands, and Indo-China to be *A. lineata.* Cram[42] recognised the existence of both species, but degraded *A. perspicillum* to a synonym of *A. galli,* separating *A. lineata* on the basis of the smaller size of the preanal sucker and of the absence of well-defined lateral alæ. *A. lineata* has been recorded also from Wales by Lewis[73]; from Canada by Baker[26]; from West Australia by Bennetts[31]; from Queensland by Roberts[86]; and from Germany, Asia, Africa, North and South America, and the Philippine Islands by Sprëhn.[97] In 1931, Ackert[8] examined a large amount of material from Cambridge (England), Kansas, Tangiers, Uganda, the Gold Coast, and India, but found only a single species present, which he referred to *A. lineata.* The existence of a second species of Ascaridia was regarded by him as uncertain. In the following year, Baylis[29] published an article setting out his reasons for regarding *A. perspicillum, A. galli,* and *A. lineata* as synonymic. He considered that the common large roundworm of the domestic fowl comprised a single species only, to which the name *A. galli* had priority. This finding has not, however, been accepted by Ackert, who in his latest contributions[17–22] to the biology of this roundworm continued to use the name *A. lineata,* stating as his reason,[8] "while the name *Ascaris galli* was given by Schrank in 1788, he did not describe the parasite, but based the species on Goeze's (1782) composite species, *Ascaris teres;* a nematode Goeze had found in dogs, cats, chickens, and raptores."

The roundworm, with which the studies set out herein are concerned, was identified as *A. galli,* of which an excellent description has been given by Ackert (*A. lineata*).[8] This identification was confirmed by Dr. H. A. Baylis, of the British Museum, to whom specimens were submitted.

The species, as has already been indicated, is world wide in its distribution, and among the domestic birds is recorded from the fowl, *Gallus gallus,* turkey, *Meleagris galloparvo,* guinea fowl, *Numida meleagris,* duck, *Anas boschas domestica,* and goose, *Anser anser domesticus.*

I. Historical.

The most outstanding name associated with studies on the biology of *A. galli* is that of Ackert. Ackert commenced his investigations in 1919 and his contributions to the literature concerned with this roundworm include studies on the life history and pathogenicity[1 2 3 4 6 7 8]

and on the resistance of the fowl to infestation. His work on resistance is particularly interesting and has been responsible for much of the present knowledge of the resistance of a host to helminth infestation. These investigations of Ackert, many of which were conducted in collaboration with other workers—Graham, Porter, Nolf, Herrick, et al.—have dealt with the effect of age,[7 16 17 19 20 21] of repeated infestation,[14] of the loss of blood,[10] of diet, [7 11 12 13 15 18] and of the several varieties of the host[17 19] on the course of an infestation. He has been able to demonstrate that the resistance of the fowl to infestation increases with age; that repeated infestations may possibly induce an acquired resistance; that loss of blood and diets inadequate in vitamins A and B or entirely of a vegetable nature may lower the host's resistance; and that the light breeds of fowl are less resistant than the heavy breeds.

Guberlet[58] confirmed Ackert's early work on the life history of the parasite and showed that there is no extra intestinal migration of larvæ except in rare instances, thereby indicating the unsoundness of a report by the Oklahoma Experiment Station,[84] in which mortalities were claimed among chicks due to an invasion of the lungs by the larvæ. Itagaki[67] is responsible, so far as can be determined from the literature available, for the only work on the life history of Ascaridia carried out in any country other than the United States. Itagaki's experiments at Tokyo, Japan, indicate a nodular condition of the small intestine due to the penetration of the wall tissues by the larvæ. No such nodule formation was ever observed by Ackert.[8]

Herrick,[63] and with Ackert[6] studied the pathogenicity of infestation with Ascaridia, and in 1926[64] was responsible for a very fine contribution on the resistance of chickens to infestation.

Very little work appears to have been carried out on the effects of the environment upon the egg. Danheim,[46] Itagaki,[67] Ackert,[3 9] Hartman,[62] and McRae,[75] have published the results of various experiments dealing with the effects of temperature, sunlight, and moisture, while Chandler[41] and Beaudette and Black[30] have given some idea of the possible use of chemicals as ovicides.

II. Prevalence and Distribution in Queensland.

In 1866, Schneider described a large species of roundworm collected from the domestic fowl in South Australia by Schromburg, under the name *Heterakis compressa.* The measurements and description given by Schneider indicate that this species belongs to the genus Ascaridia and is most probably *A. galli.* A note by Perrie[79] in 1892 on the presence of *Ascaris* sp. in the domestic fowl possibly refers to this species also. It was not till 1912, however, that a species of large roundworm was recorded from the domestic fowl in Queensland, the species being recorded by Johnston[70] as *Ascaridia perspicillum.*

A survey of the incidence of *A. galli* in the domestic fowl was made by the writer in 1932[86] when of 128, mainly young, birds examined 76·6 per cent. were infested. A further survey in 1934-1935 showed that of 579 birds, the majority of which were over three years of age, 42·1 per cent. were infested.

This roundworm is probably well distributed throughout the State as the following locality records show:—Brisbane, Toowoomba, Dalby, Goondiwindi, Charleville, Rockhampton, Townsville, Atherton, and Normanton.

III. Economic Importance.

A. galli occurs normally in the small intestine and is usually restricted in its habitat to that portion of the intestine extending between the entrance of the bile duct and the remnant of the yolk sac. In the case of heavy infestations worms may be encountered anterior and posterior to this site, though there is a greater tendency for the parasites to move forward into the duodenal loop rather than to occupy the portion of the intestine posterior to the yolk sac remnant. Occasionally specimens have been seen in the gizzard and cæcum, and it is not unusual in the case of heavy infestations for individuals to migrate into the crop and œsophagus.

In Queensland, the principal host of *A. galli* is the domestic fowl. It has been seen also in the turkey and duck. In this latter host very heavy infestations were observed in two dead birds three to four months old sent into the laboratory.

Observations on birds examined in the laboratory and on poultry farms indicate that this roundworm is harmful chiefly to young stock. Among young birds mortalities are frequent and the symptoms exhibited include marked emaciation, weakness, and anæmia, infested birds having a decidedly unthrifty appearance. Diarrhœa may accompany an infestation, but is not always associated. The appetite may be good, but the birds do not grow. Enquiries have shown that there is some evidence that the egg production may be affected, especially that of birds in their first lay.

2. THE PREPARASITIC PHASE IN THE LIFE CYCLE.

I. Technique Employed.

(i.) *Method of Obtaining Eggs.*—Fresh eggs of *Ascaridia galli* were very conveniently secured by incubating female worms in physiological saline at 37 deg. C. Under these conditions worms have remained alive as long as seventy-two hours, but only eggs deposited during the first twenty-four to thirty-six hours were used.

(ii.) *Isolation of Eggs.*—The technique employed for the examination of droppings for eggs was a modification of that advocated by Sheather, concentrated salt solution being used instead of sugar.

Eggs were isolated from dried droppings and soil by means of the method recorded by Spindler (1929).

II. Description of the Egg.

Two types of Ascaridia eggs are seen in droppings—namely, fertile and infertile.

The Fertile Egg.—The fertile egg is single-celled when passed in the droppings and is broadly oval in shape. The egg consists of a rounded mass of protoplasm, not entirely filling the shell, in which a clear central spot—the nucleus—may be detected. Enclosing the egg are three separate coats—(1) an inner thin and delicate vitteline membrane, (2) a thick transparent shell, 4μ-6μ in thickness, and (3) an outer thin irregular and inconspicuous albuminous covering to which minute particles of debris may be attached imparting to the egg a somewhat roughened appearance. Fifty fertilized eggs selected at random measured 73μ to 92μ in length by 46μ to 57μ in width, with an average measurement of 81μ by 52μ. Rarely, fertilized eggs as large as 126μ by 50μ and 117μ by 57μ have been observed. At one end of the egg and

placed slightly to one side is a small plug-like structure, which appears to be of assistance in hatching. This plug, according to Ackert[8] is a solid conical appendage of the vitelline membrane and is free from the shell.

The Infertile Egg.—Two types of infertile eggs have been observed. The first type is very similar in appearance to the fertile egg, but no clear central neuclear spot is visible. In measurements this type of infertile egg approaches those of the fertile egg, but may be proportionally longer in comparison to its width. Such an egg, for example, may measure 93μ by 42μ.

In the second type of infertile egg the shell has lost its regular oval appearance and may be misshapen and more pointed at either end. The shell is much thinner, the polar plug is missing, and the shell may be entirely or partly filled with a heterogeneous mass of protoplasm, fat, and yolk.

III. Comparison of the Egg of Ascaridia Galli with that of Heterakis Gallinæ.

In fæcal examinations of fowls in this State the only other helminth egg with which the egg of *Ascaridia galli* could be confused is that of the cæcum worm, *Heterakis gallinæ*.

Two distinct kinds of fæces are passed by the domestic fowl, cæcal fæces and intestinal fæces. Fæces from the intestine is usually formed and contains relatively coarse particles, while cæcal fæces is brown and pultaceous. The eggs of *Ascaridia galli* may occur in both types of fæces, whilst those of *Heterakis gallinæ* are usually passed in cæcal fæces only. On rare occasions, however, cæcum worm eggs are retained among fæcal debris in the cloaca and are seen in intestinal fæces. Both types of eggs are very similar in general appearance, being thick shelled, and oval with an opercular plug at one end. The egg of Heterakis is more rounded at either end with its sides less convex than those of the egg of Ascaridia. The following table, in which measurements of the eggs of the two species are given, also shows that Heterakis deposits an egg of smaller dimensions than Ascaridia. In this table are included measurements made by the writer on fifty eggs of each species.

Table I.

Heterakis gallinæ.	Ascardia galli	Authority.
65μ — 70μ × 35μ — 40μ	..	Dorman [47]
63μ — 75μ × 36μ — 48μ	77μ × 47μ	Cameron [38]
63μ — 75μ × 36μ — 48μ	77μ × 47μ	Baylis [28]
70μ — 80μ × 38μ — 44μ	80μ — 85μ × 43μ — 50μ	Mönnig [77]
74μ — 78μ × 41μ	..	Graybill [56]
63μ — 71μ × 38μ — 48μ	75μ — 80μ × 45μ — 50μ 80μ × 50μ	Cram (*A. galli*) (*A. lineata*) [42]
70μ — 80μ × 38μ — 44μ (73μ × 42μ)	..	Clapham [44]
..	73μ — 88μ × 45μ —50μ (76μ × 49μ)	Ackert [8]
65μ — 79μ × 35μ — 46μ (70μ × 39μ)	73μ — 92μ × 46μ —57μ (81μ × 52μ)	Roberts

IV. The Influence of the Environment upon the Egg.

This was determined by a series of experiments in which eggs were exposed to experimental and natural conditions of moisture, temperature, &c.

(i.) The Influence of Temperature.

Danheim[46] found that eggs in the early cleavage stages were fairly resistant to low temperatures, surviving —12 deg. C. to —8 deg. C. for fifteen but not twenty-two hours. Itagaki[67] notes that at Tokyo, Japan, eggs may survive the severe cold of January to March, but do not develop completely. Fully-developed eggs were still alive in frozen water after four months' exposure. Ackert[8] says that fertile eggs after one month's exposure of 0 deg. C. did not complete their development when removed to 30 deg. C., the morula being the highest stage of development reached before death occurred. Ackert also notes that 10 deg. C. to 15 deg. C. is the lowest temperature at which development may commence. With Cauthen, Ackert[9] found that eggs exposed in 2 inches or less of soil failed to survive subzero weather, but could live through mild winters. At 0 deg. C. to 6 deg. C. the unsegmented ovum was most resistant, then the coiled embryo, the intermediate stages of development being least resistant. As regards higher temperatures, Itagaki[67] found that during the hottest part of summer in Tokyo eggs became infective in seven days. He also noted that eggs may survive five minutes' exposure at 50 deg. C. to 53 deg. C., but not at 54 deg. C. Ackert[8] records that at 30 deg. C. eggs became infective in sixteen days and at 33 deg. C. in ten days. Twelve hours' exposure at 43 deg. C. was lethal for eggs in all stages of development.

Experimental Observations.

In the following experiments the effects of low, medium, and high temperatures on the development and viability of the fresh egg were obtained. The eggs were exposed to the various temperatures in 2 mm. of tapwater in petrie dishes.

—7·5 deg. C. to —3 deg. C.—After nine days' exposure to this range of temperatures 55 per cent. of the eggs developed to the infective embryonated stage when removed to 30 deg. C. A further eight days' exposure was 98 per cent. fatal, whilst after twenty-one days no eggs survived.

4·5 deg. C. to 10 deg. C.—At these temperatures eggs survived four weeks' exposure, but no development occurred until removal to 30 deg. C.

25 deg. C. to 26 deg. C.—The early first-stage embryo appeared after seven days' exposure, and the second larval stage was reached on the twelfth day.

30 deg. C. to 31 deg. C.—At these temperatures development was more uniform than at 25 deg. C. to 26 deg. C. and the infective embryonated stage was reached on the ninth day.

32·5 deg. C. to 33 deg. C.—Development at these temperatures was always slightly more advanced than at 30 deg. C. to 31 deg. C., and the infective embryonated stage appeared on the seventh day.

35 deg. C. to 37·5 deg. C.—After three days' exposure to these temperatures, a few of the eggs were in the small blastomere morula stage. The majority, however, were sixteen-celled and many had not advanced beyond the two to six cell stage. After a further three days no advance in development could be detected, and on removal to 30 deg. C. all eggs were shown to be dead.

45 deg. C. to 46·5 deg. C.—Twenty-four hours' exposure at these temperatures was fatal to all eggs without inducing any development.

55 deg. C. to 56·5 deg. C.—Fifteen minutes' exposure to these temperatures was sufficient to kill all eggs.

Discussion.—The optimum temperature range for egg development is from 30 deg. C. to 33 deg. C. At 30 deg. C. eggs become infective in about nine days, and at 33 deg. C. in about seven days. Using 2 mm. of distilled water Ackert gives the periods required to reach infectivity at these temperatures as sixteen days and ten days respectively. The more rapid development of the eggs as observed by the writer may possibly have been due to the use of tapwater.

Temperatures slightly higher than 33 deg. C. whilst allowing development to proceed to a certain extent are fatal if the period of exposure is prolonged. High temperatures, as shown by the results obtained from exposures to 45 deg. C. to 46·5 deg. C. and 55 deg. C. to 56·5 deg. C. prohibit development entirely and are rapidly fatal.

Prolonged exposure to very low temperatures is also fatal, though eggs survived sixteen but not twenty-one days to —7·5 deg. C. to —3 deg. C. Lower temperatures, however, are, according to Danheim,[46] more rapidly fatal, fresh eggs not surviving twenty-two hours at —12 deg. C. to —8 deg. C.

Temperatures of 4·5 deg. C. to 10 deg. C. did not induce any loss of viability after four weeks, but were sufficiently low to prohibit development during the period of exposure.

In Queensland very low temperatures do not occur for any length of time in any of the poultry-raising districts, the mean minimum temperatures for June, July, and August in the coldest district—Stanthorpe —being about 2·5 deg. C., 1·1 deg. C., and 1·6 deg. C. respectively. High temperatures on the other hand, especially in unshaded areas, are frequently encountered, and these may be expected to possess some lethal effect in view of the comparatively slight resistance of the egg to temperatures in the vicinity of 55 deg. C. and over.

(ii.) The Influence of Sunlight.

Ackert and Cauthen[9] have noted that ova in less than half an inch of soil when exposed to the summer sun were killed in three weeks, whilst eggs in shaded spots remained viable from spring to autumn. Hartman[62] has recorded an experiment in which all eggs on the soil surface and down to a depth of 6 inches in unshaded soil were killed during July-August, a hot dry season, whilst eggs in shady spots maintained their viability for 100 days. Eggs on the soil surface died first, frequently within a few hours, but no eggs at any depth survived five weeks. Ackert[1] says that eggs exposed to sunlight at 23 deg. C. to 33 deg. C. continued to develop throughout seven days' exposure.

EXPERIMENTAL OBSERVATIONS.

In the experiments described below the influence of sunlight upon the egg of *Ascaridia galli* was studied in three ways—(*a*) upon fresh and embryonated eggs in liquid medium, (*b*) upon fresh and embryonated eggs under conditions of desiccation, (*c*) upon fresh eggs in droppings, associated with conditions of moisture and of desiccation.

(*a*) *The Influence of Sunlight upon Fresh and Embryonated Eggs in Liquid Media.*

In these experiments eggs were exposed to sunshine under 2 mm. of tapwater.

Fresh Eggs.—Fresh eggs in the one and two celled stages were exposed to bright sunshine for three, four, and five hours. The only eggs to develop to the embryonated stage after subsequent incubation at 31 deg. C. to 32 deg. C. were those exposed to sunlight for three hours, 22 per cent. of the eggs surviving the exposure, a control culture yielding 92 per cent. embryonated eggs. The maximum sun temperatures recorded during these periods of exposure ranged from 36 deg. C. to 42 deg. C.

Embryonated Infectious Eggs.—Exposure of eggs containing infectious embryos to bright sunshine with maximum temperatures 36 deg. C. to 42 deg. C. showed that after three hours' exposure 37 per cent. of the embryos were still alive, whilst a four-hour exposure was entirely lethal. Approximately 95 per cent. of the embryos in eggs retained in the shade as a control were alive after two weeks.

(*b*) *The Influence of Sunlight upon Fresh and Embryonated Eggs under Conditions of Desiccation.*

In order to determine the effect of sunlight upon fresh and embryonated eggs under conditions of dryness, eggs were dried out on glass slides for two days and then exposed to sunlight. Control eggs were similarly treated, but retained in the shade, and when remoistened indicated that the short period of desiccation had been without any effect upon their vitality.

Fresh Eggs.—Fresh eggs in the single and two celled stages dried out on glass slides and exposed to bright sunshine with maximum temperatures of 37 deg. C. to 40 deg. C. did not survive two hours' exposure, though one hour's exposure did not give a mortality greater than 38 per cent.

Embryonated Infectious Eggs.—After one hour's exposure to bright sunshine and with a similar range of temperatures, practically all eggs in this stage of development survived, but a further hour's exposure proved completely lethal.

Discussion.—These experiments have shown that bright sunshine is inimical to the egg of *Ascaridia galli* and that in 2 mm. of tapwater all eggs, both fresh and embryonated, were killed after three to four hours' exposure. Under conditions of desiccation, however, the period of exposure necessary to give a 100 per cent. mortality was reduced to one to two hours. This latter experiment has also suggested that the egg containing an infectious embryo is more resistant to sunshine than the fresh egg. After one hour's exposure under conditions of desiccation 38 per cent. fresh eggs were killed, whilst practically all the embryonated eggs were still alive.

(*c*) *The Influence of Sunlight upon Eggs Exposed in Fresh Normal Droppings.*

Under Conditions of Moisture.—Six normal-sized droppings from infested chickens were exposed to sunshine on earth in small wooden boxes and kept moist by frequent sprinkling with water.

Six similar normal-sized droppings kept moist were retained in the laboratory as controls.

After various periods of exposure a single dropping was removed to the incubator at 31 deg. C. to 32 deg. C. and left there for ten days before being examined.

The results from this experiment are given in the following table:—

TABLE II.

SUNSHINE.			SHADE (Controls).		
Period of Exposure.	Number of Eggs Examined.	Per Cent. Survival.	Period of Exposure.	Number of Eggs Examined.	Per Cent. Survival.
7 days ..	154	62	9 days ..	250	89
14 days ..	310	57	22 days ..	210	94
23 days ..	177	2	24 days ..	476	91
28 days ..	206	3	43 days ..	155	93
40 days ..	239	..	54 days ..	328	82
45 days ..	116	..	54 days ..	334	90

Discussion.—By the end of the third week the frequent moistening had resulted in the disintegration of the droppings, especially of those exposed to the sun, and from this time until the conclusion of the experiment these were scattered in a thin layer over the soil surface. In taking samples for examination scrapings were made of the soil surface only.

During the total period of exposure there were many partly cloudy days and seven completely cloudy days with rain. Minimum temperatures ranged from 13·5 deg. C. to 21 deg. C. and maximum temperatures from 34 deg. C. to 45 deg. C.

Under the conditions governing the experiment, eggs survived for approximately twenty-eight days with a very marked mortality between the fourteenth and twenty-third days. When compared to an exposure of fresh eggs and embryonated eggs in liquid media, when death resulted after three to four hours, it is apparent that the protection of the egg from sunlight afforded by the moist fæcal and earth particles was responsible for the increased survival period. It would seem very probable, therefore, that had the degree of moisture been such as to promote development, without in any way resulting in disintegration of the droppings, the eggs would have resisted exposure to sunlight for a considerably longer period.

Under conditions of Desiccation.—In this experiment six normal-sized infested droppings were exposed to sunlight on earth and allowed to dry out. They were given approximately seven hours' exposure each day, except during week-ends, when they were retained in the laboratory. During rain and at night they were also not exposed.

As controls six similar droppings from the same chickens were kept in the laboratory and allowed to dry out.

The results of this experiment are given below as determined from subsequent moistening and incubation of the eggs at 31 deg. C. to 32 deg. C.

TABLE III.

SUNSHINE.			SHADE (Controls).		
Period of Exposure.	Number of Eggs Examined.	Per Cent. Survival.	Period of Exposure.	Number of Eggs Examined.	Per Cent. Survival.
7 days ..	222	76	7 days ..	128	90
14 days ..	254	35	14 days ..	304	80
20 days ..	361	..	21 days ..	296	65
21 days ..	278	..	29 days ..	472	20
21 days ..	102	..	37 days ..	264	2
21 days ..	316	..	42 days ..	292	..

Discussion.—During the total period of exposure there were many partly cloudy days and four completely cloudy days with rain. Minimum temperatures in the sun ranged from 13·5 deg. C. to 21 deg. C. and maximum temperatures from 34 deg. C. to 43 deg. C. Under these conditions eggs in droppings exposed to sunshine survived fourteen but not twenty days, whilst in the shade their longevity was increased to between thirty-seven and forty-two days. Eggs in droppings exposed to sunshine and in the presence of moisture maintained their vitality for about twenty-eight days, and it may therefore be concluded, especially as the two experiments were carried out at the same time, that the condition of desiccation were responsible for this greatly decreased survival period.

(iii.) THE INFLUENCE OF LIGHT.

Itagaki[67] noted that fresh eggs kept in pitch darkness did not develop and died within a few days. No such effect was observed by the writer among eggs which were exposed to darkness for a period of thirty-seven days. The percentage of embryonated eggs in the culture so exposed—namely 92 per cent.—compared very favourably with that in a culture left on the bench in the laboratory adjacent to a window—namely, 90 per cent.

(iv.) THE INFLUENCE OF OXYGEN.

That oxygen is necessary for egg development has been shown by Itagaki,[67] who says that freshly-discharged eggs kept in a culture medium free from oxygen failed to develop and died within a few days.

(v.) THE INFLUENCE OF DESICCATION.

The influence of dryness upon the egg has also been investigated by Itagaki,[67] who noted that fresh eggs maintained in a desiccator for forty-four days did not develop completely and subsequently died. Embryonated eggs on the other hand were still alive after sixty days. McRae[75] showed that at 22 deg. C. a minimum relative humidity of 82 to 86 per cent. was necessary for complete development. With a relative humidity of 40 per cent. to 50 per cent. development in some of the eggs reached the tadpole stage, but all eggs were dead after eight days. When the relative humidity was increased to 77 per cent. to 82 per cent., the eggs maintained their viability for from two to four weeks, but did not develop beyond the morula stage. Eggs kept in a saturated atmosphere at 30 deg. C. developed exactly as did those in water at the same temperature.

EXPERIMENTAL OBSERVATIONS.

In the following series of experiments the influence of desiccation was determined by:—

(*a*) Ascertaining the longevity of fresh and embryonated eggs dried out on glass slides and exposed to room temperatures and humidities.

(*b*) Ascertaining the longevity of fresh eggs in normal-sized droppings, allowed to dry out and remain dry under room temperatures and humidities.

The influence of desiccation in the presence of sunlight has already been discussed.

(a) Eggs Dried Out on Glass Slides.

Fresh Eggs.—Eggs in the one and two celled stages were allowed to dry out on glass slides. After various periods of exposure the eggs were moistened and were incubated at 31 deg. C. to 32 deg. C. for ten days before examination. The results of this experiment are given herewith in tabular form.

TABLE IV.

Period of Exposure.	Number of Eggs Examined.	Per Cent. Survival.
1 day (control)	554	94
7 days	786	78
14 days	642	70
21 days	754	25
26 days	903	5
30 days	859	..

The minimum and maximum temperatures recorded during this period were 15 deg. C. and 25·5 deg. C. respectively. Humidities were consistently high, rarely below 50 per cent. and on many occasions as high as 80 per cent. Under these conditions eggs continued to develop slowly, but did not reach the morula stage. During the first fourteen days the percentage of eggs unable to withstand the dry conditions showed a gradual increase. During the next seven days there was a marked mortality, so that only 25 per cent. of those eggs examined on the twenty-first day were alive. On the twenty-sixth day only 5 per cent. were viable, whilst all eggs exposed for thirty days proved to be dead. The fact that eggs submitted to the conditions of desiccation, &c., outlined above developed as far as the morula stage indicates that the moisture requirements for development are comparatively slight.

Embryonated Infectious Eggs.—Embryonated infectious eggs were subjected to the same conditions of desiccation on glass slides as fresh eggs. Examination after various periods of exposure gave the following results:—

TABLE V.

Period of Exposure.	Number of Eggs Examined.	Per Cent. Survival.
1 day (control)	1,084	93–90 after 6 weeks
7 days	886	95
12 days	972	72
15 days	985	35
20 days	728	45
25 days	1,210	12
30 days	956	..

Moistening of infectious embryonated eggs after periods of desiccation induces hatching, and it was noticed that although a large number of eggs appeared to have survived immediately after moistening many of these had hatched when examined again fifteen to thirty minutes later. It was therefore decided to delay examination till twenty-four hours after moistening, and only unhatched eggs containing live larvæ were considered as surviving the respective periods of desiccation. The temperatures and humidities were the same as those given for fresh eggs.

(*b*) *The Effect of Desiccation on Eggs in Normal-sized Droppings.*

This experiment has already been detailed as a control among the experiments conducted to ascertain the influence of sunlight and desiccation, and it was shown that under the conditions outlined eggs survived thirty-seven but not forty-two days.

Discussion.—The above experiments have shown that whilst the moisture requirements for development appear to be comparatively slight, conditions of dryness may eventually result in the death of all eggs so exposed. Both fresh eggs and embryonated infectious eggs dried out on glass slides survived twenty-five but not thirty days. Infectious embryonated eggs appear more resistant to desiccation than eggs in early stages of development. After twenty-five days' exposure an examination showed that immediately after moistening approximately 65 per cent. of the embryonated eggs appeared to contain live embryos, but after a further twenty-four hours, hatching had reduced this number to 12 per cent. It would appear that the eggshell is able to absorb water after periods of dryness, as in this instance hatching appeared to be definitely associated with remoistening, the shell swelling and splitting in the vicinity of the polar plug, irrespective of whether the contained larva was alive or dead, but more frequently in the case of live larvæ. Twenty-four hours after hatching such hatched larvæ were always dead.

Eggs in normal-sized droppings were alive after thirty-seven but not forty-two days, the increased survival period being due no doubt to a retention of moisture by the fæcal particles.

(vi.) The Influence of Chemicals upon the Vitality of the Egg.

In 1926 Beaudette and Black[39] conducted laboratory and field tests with various chemicals in order to ascertain their use as ovicides for the control of Ascaridia. Infested runs were treated with a 1–1,000 bichloride of mercury solution, with a 5 per cent. formaldehyde solution, with 5 per cent. hydrochloric acid, and with 5 per cent. phenol. Only in the case of treatment with 5 per cent. phenol did clean birds subsequently introduced to the runs remain uninfested. It has also been noted by Chandler[40,41] that an "iodine suspensoid" is an effective ovicide.

In the tests carried out by the writer the aim was to discover some solution which would be practically instantaneous in its lethal effects and be economical to use. Various dilutions of a large number of chemicals were employed over a period of twenty-four hours, but the only chemicals which gave any promise were carbolic and cresylic acid which in this period of time were effective in 2 per cent. and 1 per cent. dilutions respectively. Boiling water was instantly lethal, and it is considered that from these results a 5 per cent. boiling solution of a disinfectant with a high phenol and cresol content would be the most

efficient ovicide to employ. That such a solution is more effective than water alone at high temperatures has been demonstrated by the writer[88] in the case of the eggs of *Ascaris lumbricoides*.

Obviously such a solution could not be economically applied to runs of any size possessing earthen floors, but it is considered that it could be very advantageously used in houses with concrete or wooden floors. The solution should be used liberally and the time between the removal of the boiling solution from the fire and its application to the floors should be reduced to a minimum.

V. The Longevity of the Egg.

The only records of the longevity of the egg are those noted by Ackert and Cauthen,[9] when in an experiment involving out-of-door conditions eggs in shaded spots remained viable from spring to autumn, and by Hartman,[62] who in a similar experiment obtained a longevity of 100 days for eggs protected from sunlight.

The longevity of the egg of *Ascaridia galli* was studied by the writer under optimum conditions in the laboratory and also under conditions of exposure to the natural environment.

(*a*) Under Laboratory Conditions.

In this experiment eggs were maintained at room temperatures in 2 mm. to 4 mm. of tapwater. The media received frequent shakings in order to ensure an adequate supply of oxygen being always present. Some few weeks after the experiment was commenced the media contained a good growth of algæ, which was allowed to remain, as it was considered that the photosynthetic processes would assist in maintaining a supply of oxygen. Eggs were removed at intervals and the percentage of live eggs computed. These are given in the table set out below.

Table VI.

Date.	Number of Days.	Number of Eggs Examined	Per Cent. Survival.
1–10–34 ..	Fresh eggs	..	..
17–10–34 ..	17	325	88 embryos
8–2–35 ..	131	268	84
27–3–35 ..	178	454	80
26–4–35 ..	208	510	75
17–6–35 ..	260	510	55
5–8–35 ..	309	482	35
3–10–35 ..	368	316	6
4–11–35 ..	400	725	..

Thus in this experiment eggs survived 368 but not 400 days. The percentage shown on the seventeenth day refers to the percentage of embryonated eggs which developed in the culture used. Thereafter the percentages given refer only to the number of embryonated eggs that survived. In view of the much greater periods of longevity which have been recorded for eggs of other species of Ascaridæ, it is felt that the period of longevity for the eggs of *A. galli* as determined by the writer would probably be considerably increased by further experiments. On the other hand, although the eggs of certain species of Ascaridæ have been credited with surviving for a number of years, these records are based principally on the appearance of the embryo within the eggshell, and it seems possible that eggs kept for any great length of time may

not be infectious, due to a loss of vitality of the larvæ and their subsequent inability to establish themselves. For instance, in the case of *Ascaridia galli*, it was found that by feeding embryonated eggs 184 days old to young chicks numerous larvæ could be recovered. Embryonated eggs 230 days old were also found to be infectious, though the numbers of larvæ recovered was only a very small percentage of the eggs fed, but from a chicken to which eggs 368 days old were fed no larvæ were secured.

(*b*) Under Natural Conditions.

In this experiment wooden boxes were sunk into the soil to ground level. The boxes were without bottoms and their sides were pierced with ¾-inch holes in order to interfere as little as possible with drainage and soil moisture currents. Droppings containing fresh eggs of Ascaridia were spread over the soil in the boxes to a depth of ½ inch. Two such boxes were placed in a permanently shaded position under a tree, in which position the eggs would be protected from sunlight and at the same time benefit from any natural precipitation. Two other boxes were placed so that they would be continuously exposed to sunlight. At intervals surface scrapings to a depth of about ½ inch were taken from the soil and examined for eggs.

The conditions of sunlight, temperature, and rainfall prevailing during the experiment were practically normal for the Brisbane district, in which the experiment was carried out.

The droppings were exposed on 7th January and it was found that by 20th April a few live embryonated eggs still existed in the earth exposed to sunlight, but by 2nd June all eggs had died. This gives a longevity for eggs in this experiment of about 103 days.

In the boxes placed in the shade, however, a very small proportion of eggs were still alive on 13th September, but only dead eggs were seen in examinations made in October, a survival period of about 249 days.

[TO BE CONTINUED.]

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Clovers and Trefoils in Queensland.

* C. T. WHITE, Government Botanist.

THE most important group of fodder herbs in the world's agriculture are the clovers and trefoils. A very marked increase in the clover and trefoil content of the pastures during the past couple of seasons has been evident to dairymen and pastoralists in South-eastern Queensland. This increase has been going on steadily but surely for a number of years, and a couple of good winters and springs recently accelerated the process, with the result that in many pastures during July and September clover is now the predominant plant, so much so that some pastoralists have become alarmed lest the clover become too dominant, choking out what little spring grasses and other fodders might be available.

In some localities it is the exact reverse, and farmers claim they have tried to establish clovers for years in the pasture without any result. Why this should be is generally difficult to say, but the application of superphosphate at the rate of one to two hundredweight per acre before or at the time of sowing should help considerably. Once even a small stand is obtained this should gradually increase as stock are ideal spreaders of these plants.

The question often asked is what is the difference between a clover and a trefoil. In older countries the terms are synonymous, and no distinction is drawn between them, but in Australia the term "clover" is more or less restricted to plants of the genus Trifolium, and trefoils to plants of the genus Medicago, and to a lesser extent to allied genera.

Clovers or trefoils are not distinguished from their allies by the leaves alone, but mainly by the pods which are enclosed in the calyx or in the corolla. The flowers are mostly in heads. In the trefoils or Medicagos the pods protrude from the calyx, and the corolla is always caducous, that is, it falls off soon after the full development of the flower. The flowers may be in heads, but more often are in short spikes or racemes.

The clovers are divisible into two groups, the perennial and annual sorts. The perennial sorts seen in Queensland are the White Clover (*Trifolium repens*), Red Clover (*Trifolium pratense*), Alsike Clover (*Trifolium hybridum*), Strawberry Clover (*Trifolium fragiferum*), and the Shearman's Clover (a variety of *Trifolium fragiferum*).

The dominant clover in most places is the ordinary White clover or White Dutch, and this still remains the premier pasture clover for South-eastern Queensland. Various strains have been imported from England, New Zealand, and elsewhere, but so far as I know these have not shown under Queensland conditions any improvement over the common local one. White Clover is a native of the British Isles and Central Europe, but is now widely dispersed, being the commonest clover in cultivation over all the warm temperate countries of the world.

Red clover has never been cultivated in Queensland to any extent, but recent trials show it to stand the climate remarkably well. It is a much larger plant than White Clover, and is not of a creeping, but of an upright habit. It possesses very hairy leaves and stems, and the flowers are reddish purple, being borne in fairly large heads. It is not a general

* In a broadcast from Radio Stations 4QG, Brisbane, and 4RK, Rockhampton, by courtesy of the Australian Broadcasting Commission.

pasture legume in the same way as White clover, but is essentially a clover for sowing in small areas, say 2 to 5 acres, either on its own or mixed with other winter grasses such as Prairie, Rye, Cocksfoot, and Phalaris grasses for grazing off. When sown by itself it is more apt to cause bloat than when mixed with grasses. Autumn is the recognised time for sowing, though I have seen (on the property of Mr. J. M. Newman, Caboolture) a crop sown as late as August, showing an excellent stand some fifteen months later, having gone right through the summer. It is a very short-lived perennial, and its life in Queensland would probably only be two to three years. Preventing seeding by cutting or judicious stocking will lengthen the life of the plants.

Alsike Clover is similar to White Clover in general appearance, but is easily distinguishable by its pink or red flowers. Odd specimens of what is apparently this clover have been received from Obi Obi. These are the only Queensland specimens I have seen, and it probably has little future in Queensland, as it is said to prefer colder climates, and according to Breakwell, one-time Government Agrostologist in New South Wales, is one of the first clovers to succumb rapidly on the approach of hot, dry, summer weather.

Strawberry and Shearman's Clover have been tried to a very limited extent in Queensland. Mr. A. Francis, of Kin Kin, sent me specimens of the former a year or two ago, with a report that it did well in the wetter parts of the district, favouring creek flats and banks, and growing well into the water. Dr. V. R. Wilson, who is experimenting with grasses and fodders at Brisbane and Yandina, informs me that Shearman's is doing well in both places. Both clovers are quite unsuited for dry situations, but have marked possibilities for the wet coastal parts of South-eastern Queensland. Shearman's Clover is the more vigorous of the two, and in New South Wales is said to grow quite well on slightly saline coastal flats. Little or no seed is set as a general rule, but both clovers are easily spread by cuttings or divisions.

Of annual clovers, the Cluster Clover (*Trifolium glomeratum*), the Woolly Clover (*Trifolium tomentosum*), the Hop Clovers (*Trifolium procumbens,* and *Trifolium dubium*), and the Haresfoot Clover (*Trifolium arvense*) are all established in Queensland, never sown, but coming up spontaneously. Of these the best is the Cluster Clover. Authorities speak well of this species in the other States, and it has been recommended for sowing during the autumn months. It does remarkably well in Queensland, and during the past two or three years, judging from samples received for identification, is very much on the increase. Where it has been abundant in some pastures, stock have been noticed to show marked preference for it.

The Woolly Clover is somewhat similar, but, I think, of less value. A number of specimens are received nearly every year for identification, but it is not nearly so common as the Cluster Clover. It is easily distinguished by the small globular heads borne in great abundance, and with individual flowers covered with short white cottony wool.

Trifolium procumbens and *Trifolium dubium* are two very closely allied species. The former is much larger in all its parts, and has many more flowers in the head. Both are known as Hop Clovers. They are very common in coastal Queensland, and have been much on the increase during the past few years, particularly the smaller one. They seem to be readily eaten by stock.

Haresfoot Clover is a very distinctive species, distinguished by having cylindrical flower heads, the individual flowers being small and pink. The corolla is covered with fine hairs, the whole appearance of the flower head resembling a small haresfoot, hence the local name. It is seen growing now and again on the Darling Downs and in the Granite Belt, but not in any great abundance. It is not regarded as having much value as a fodder.

Annual clovers not growing wild, but only growing under cultivated conditions in Queensland are Crimson Clover (*Trifolium incarnatum*), Subterranean Clover (*Trifolium subterraneum*), and Egyptian or Berseem Clover (*Trifolium alexandrinum*). The first of these, the Crimson Clover, is distinguished by its hairy stems and leaves, and red flowers. It is somewhat similar to Red Clover, but the flower heads are more narrow-cylindrical, and the plant is of annual duration.

I had received specimens from the cooler parts of the State at odd times, but last year received specimens from Mr. D. Kennedy, of Kilcoy, who has experimented with winter grasses and legumes, with a report that it had shown up the best of all the clovers he had tried. It apparently lasted well into the hot weather, as flowering specimens were received towards the end of November, and under date 23rd January, Mr. Kennedy wrote that it was just dying off.

Subterranean Clover is a native of Western and Southern Europe that plays no important part in agriculture in its native country, nor in North America, but in the Southern States of Australia has proved itself one of the most useful and important fodders ever introduced, especially for increasing the carrying capacity of second class country. From its natural range, one would expect it to grow under much the same conditions as the common Burr Trefoil, except that it would be more susceptible to heat, and this apparently is the case in Australia, and the reason why it has not succeeded in Queensland to the extent it has in the Southern States. It may yet, however, have a future in this State through the perpetuation of strains more suited to Queensland conditions, and that are gradually naturalised and increased.

Egyptian or Berseem Clover has been cultivated on the Darling Downs from time to time, and does fairly well. I have not seen it growing, nor have I received specimens for some years, so that it must have gone out of favour, probably for the reason that it is not suitable for grazing, but is mostly grown for hay. Where it will grow, generally speaking, lucerne does as well, and is much better for the purpose. The only slight advantage it may possess over lucerne is that it produces earlier winter feed, but it probably has not a future in Queensland.

The Medics or Trefoils can be divided into two groups—namely, those in which the pods are provided with spines, the other in which the pods are smooth and spineless. Of the burr-forming species three are naturalised in Queensland—namely, the common Burr Trefoil or Burr Medic (*Medicago denticulata*), the Woolly Burr Trefoil (*Medicago minima*), and the Toothed Medic (*Medicago laciniata*). All are annuals, and may start to grow any time from April to August, continuing into the spring months, dying off on the approach of hot weather. The most abundant and widely distributed is the common Burr Trefoil, and during the spring months in many places this is one of the commonest

fodders on parts of the Downs, Maranoa, and some other districts. In its green luscious state it is apt to bloat stock, though, generally speaking, stock prefer the plant when cut, wilted, or when it is dying off. When it has properly died off, about late October or November, stock greedily eat up the burrs, and these containing the seeds are in consequence very nutritious. The only disadvantage of the plant is that the burrs badly infest the belly wool of sheep, and on this account the value of the plant is minimised in purely sheep-raising areas, though on the whole its good qualities probably outweigh the bad.

The Woolly Burr Trefoil is much smaller in all its parts, and the leaves and stems are hairy, not smooth. Its properties are much the same as those of the common species, and it is very abundant on parts of the Darling Downs and Granite Belt.

The Toothed Medic is characterised by having the margins of the leaves cut by large irregular teeth. The pods are large and borne in great abundance. On the whole it comes up rather earlier than the other two species, and I have seen specimens one mass of nearly ripe pods as early as August. It is quite abundant in some parts of South America, and is there looked upon as a valuable fodder.

Of Medics or Trefoils with spineless, not burr-like, pods, the two commonest naturalised in Queensland are the Button Medic or Button Trefoil (*Medicago orbicularis*) and the Black Medic or Common English Trefoil (*Medicago lupulina*). The former is a very valuable species. coming up naturally every now and again on parts of the Darling Downs. The pods are flat with several spirals, and are somewhat button-like in appearance. Not being armed with hooks or spikes, they do not attach themselves to wool nor hair of animals, and so are not anything like so widely spread as the burr-bearing sorts. It is a species worth encouraging, and seed should be sown during the autumn months.

The Black Medic or Common English Trefoil is generally recognised as a perennial, though in Queensland, like a lot of European plants that become naturalised here, it is of annual character. It has generally been recommended for colder localities such as the Granite Belt, but seems much on the increase, being found as far north as the Atherton Tableland.

In conclusion, I might say that the Department is always anxious to receive specimens of legumes or pasture plants from farmers and pastoralists. Small numbered pieces in flower or pod should be sent and notes retained of the specimens or preferably duplicates kept similarly numbered, when names and reports on the value of the plants corresponding to numbers will be returned.

QUEENSLAND SHOW DATES.

July.

Proserpine, 3 and 4.
Kilcoy, 2 and 3.
Bowen, 8 and 9.
Townsville, 14 to 16.
Cleveland, 10 and 11.
Ayr, 10 and 11.
Rosewood, 10 and 11.
Nambour, 16 to 18.
Charters Towers, 21 and 23.
Cairns, 21 to 23.
Maleny, 23 and 24.
Atherton, 28 and 29.
Gatton, 29 and 30.
Caboolture 31 July and 1 August.

August.

Barcaldine, 4 and 5.
Pine Rivers, 7 and 8.
Royal National, 17 to 22.
Home Hill, 28 and 29.

September.

Tully, 11 and 12.
Innisfail, 18 and 19.
Malanda, 30 September and 1 October.
Southport, 26.
Imbil, 4 and 5.
Pomona, 11 and 12.
Beenleigh, 18 and 19.

Shade Trees.

PART I.

W. D. FRANCIS, Assistant Government Botanist.*

IT is not my intention to confine my remarks to the purely utilitarian aspect of trees. Even when trees are planted primarily as shelters for stock they exercise another influence. They contribute to the appearance of the farm or the home or the town where they grow. This effect of trees on appearances may be so far-reaching as to enhance the value of a farm or home by hundreds of pounds. Any homestead which is surrounded by trees of pleasing appearance and comfort-giving shade is clearly of higher monetary value than one in which the environment of the house is neglected. Until we come to think about them, many of us scarcely realise the part which trees play in our ordinary lives. In most cases trees have long lives. They often live much beyond the span of the average human life. So, from the earliest days of childhood's perception right through to old age, our eyes are accustomed to trees, unless, of course, we are unfortunate enough to live in a treeless land. Thus it is that trees are often taken, in the ordinary course, just as part of the landscape.

As trees have such an important influence on the farm, the home, and the town, we shall briefly consider some tree types. Side by side with this, reference will be made to the significance of these types. These considerations may be useful to those who are planning the cultivation of trees in the near future. They may help in the decision of the kind of trees to plant, whether native or exotic.

One can see the types of trees from other lands in parks and gardens. Or, when one has been abroad, generally excellent opportunities have presented themselves for seeing the kinds of trees growing in the countries visited. A few years ago, on a voyage to England, I noticed some of the types of trees growing in the countries at which we called. I shall briefly mention some of these impressions, although I am aware that many readers may have noticed the same things.

In Beautiful Colombo.

At Cocos Island, in the Indian Ocean, cocoanut palms are the chief feature of the vegetation. Like so many other palms, the cocoanut is remarkable for the elegant sweep of its long leaves. The impression it conveys is that of tropical luxuriance. This impression is an accurate one, for this palm does not flourish far from the tropics, a fact which is well exemplified on the Queensland coast. The cocoanut palm also dominates the view of Colombo from the harbour. But while driving about the streets of the town one is impressed by the number and variety of broad-leaved trees growing in the streets and around the bungalows of the European quarter. These beautiful trees contribute in a very large way to the charming effect of the setting of the bungalows. A fairly large percentage of these graceful and rest-giving trees belong to the legume family. While admiring these trees and their transforming effect it occurred to me that we have almost or quite equal opportunities for growing these types of trees in Brisbane.

A Treeless Land.

The next port of call, Aden, gives one a grim notion of a treeless land. Except for a small artificial park at the water's edge, the scarred,

* In a broadcast talk from Radio Stations 4QG, Brisbane, and 4RK, Rockhampton, by courtesy of the Australian Broadcasting Commission.

bold, rocky hills are treeless. In the fierce unrelenting glare of the tropical sun these rugged hills have a forbidding but wierdly impressive aspect.

Australian Gums at Gibraltar.

Upon entering the quaint little township of Gibraltar almost the first things one sees after leaving the pier are the gum trees in the small formal town square. So the Australian at Gibraltar very early comes into contact with trees of his own land.

Unter den Linden.

The chief thoroughfare of Berlin derives its name, Unter den Linden, from the double row of linden trees which grow along it. Perhaps my expectations conceived from the name Unter den Linden were too high. I was somewhat disappointed with the lindens. They looked rather small. However, it was winter time, and they were bare of leaves. The broad thoroughfare itself, however, is certainly impressive.

The Trees of the Old Country.

In England we see, in their own setting, the trees with which so many of our grandparents were familiar. With the exception of the beech forest specimens, most of the English trees are low set, bushy-headed types. Considered as shade trees they are certainly good examples, with their short stems and large heads of foliage. But to the appraising eye of the Queensland coastal timbergetter they would make no appeal, at least in the economic sense. Not only the timbergetter, but many other Australians, have become accustomed by their environment to trees with long, column-like, unbranched stems, carrying foliage high up in the air. It is the long stems of such trees which attracts the calculating sense of the timberman, as it promises many feet of millable timber.

However, the trees of the old homeland, such as the beech, the oak, and the elm, are types that are not readily forgotten by the immigrant. Through many centuries these kinds of trees have impressed themselves on the minds of British and European peoples. The beautiful English countryside derives much of its charm from these trees. So it is natural that those who cherish memories of their old homes beyond the sea might prefer to surround themselves with trees of the English and European type.

Even town and country people in Australia often have different ideas as to the types of trees which are desirable on the farm and around the home. In many of the towns exotic trees often figure largely in the prospect. Some of these exotic trees about towns are often useful shade trees, and add considerably to the pleasing appearance of the outlook.

The Charm of our Native Flora.

However, with those who have lived in the country for a very large proportion of their lives the conditions are different. Through many years of constant association with them, the forms of the native trees have become impressed upon the mind. Unlike the early immigrants from Britain, who found our trees weird and unfamiliar, the Australian country dweller mostly likes the trees with which he is surrounded. Actually, in many cases, the bushman's ideal of a tree has been moulded by his long experience out of doors. To him the Australian type of tree, in so far as it is characteristic, has become the most desirable of all.

Perhaps the most outstanding of all Australian trees are the gums or eucalypts, which are so familiar in most Australian bush lands. A fairly good example of a gum tree is furnished by the common blue gum. This tree is very common along many watercourses, such as the Brisbane River. It is also common on much of the flat land of coastal Queensland and New South Wales. At the base of the stem there is often some hard dark bark. The remainder of the stem, and all of the branches, are covered by a smooth pale bark. The foliage is pendent and graceful. Viewed in its natural setting, the whole effect of this tree is extremely attractive. As well, it is typical of very much of Australia's tree flora. The branching system of the blue gum, its pale smooth bark and narrow pendulous leaves, are all properties which are shared by a number of other very common and widely-distributed eucalypts.

The blue gum is a prominent feature of the famous Bega grasslands, situated in New South Wales towards the Victorian border. The rich pasture lands of the Bega district were exploited early in Australian settlement. They are well known for the quality of their dairy produce. Much of the Bega country is derived from a granitic soil. In contour it is gently undulating. Dotted about these beautiful slopes are many fine blue gum trees. The general effect is that of a pleasing well-kept park. Thus these unique park lands of the Bega district owe much of their charm and industrial utility to the native trees which grow on them.

Trees of the Queensland Jungle Lands.

Those who have lived in areas originally clothed with scrub or rain forest have become accustomed to the peculiar type of tree so prevalent in the rain forests. These trees are commonly seen in parts of the North Coast line. Their chief features are the very long unbranched stems, capped by a dense but not extensive foliage crown. These are extremely graceful types, but of only limited value as shade trees. Only very few of these rain-forest species will develop a long unbranched stem when grown in the open. The Queensland kauri pine is one of the exceptions. This handsome tree is a tall-growing kind, which produces a long stem in open situations. The hoop pine, another native species, makes a very decorative figure in open situations, and by its spire-like shape is well adapted to planting about a homestead for pleasing and formal effect. Its rather narrow shape precludes it from being an extensive shade provider.

Many of the scrub species make excellent shade trees when they are grown in the open. In areas of felled scrub, in which some of the tree stumps have not been killed by fire or exposure, these stumps often shoot and grow into trees again. In these instances the competition for light is no longer present, and the trees develop a spreading and dense foliage crown. In these partially burnt areas some magnificent specimens of scrub trees assuming the habit of open spaces are often seen. The special advantage of the scrub species as shade trees consists of the dense and dark-coloured foliage which they mostly possess. These trees mostly provide much better shelter from the sun and wind than the eucalypts or gum trees. Often they may not grow so quickly as the eucalypts, and in many cases they prefer better soil conditions. However, there are very few farms with soil conditions too impoverished to grow at least some species of the scrub trees. Although these trees grow to the best advantage in places with the rainfall approaching that of the coastal areas, some of them show themselves to be quite well adapted to fairly

dry areas. For example, one often sees the familiar white cedar as the commonest street tree in western towns with an annual rainfall as low as 20 inches.

Fodder and Shade Trees of the West.

In the western areas of the State there are also admirable and useful types of trees. These trees in many cases serve as fodder as well as shelter. Like the eucalypts and gum trees in their areas, the western trees are seen at their best in their own setting. As types of western trees, one can mention the kurrajong, the bottle tree, the wilga, the cypress pine, the bauhinias, and the emu apple. With the exception of the cypress pine, most of the western trees develop only a short stem and a fairly large head of foliage. In the wilga this foliage crown is often very dense and symmetrically rounded. The wilga is a beautiful tree. Its name has a pleasing sound, although it is reminiscent of the wild dark children who roamed the western plains and whom we have dispossessed.

[TO BE CONTINUED.]



PLATE 33.

One of the many unnamed waterfalls in the Lower Coomera, near Binnaburra, Lamington National Park, Macpherson Range, Queensland.



THE VALUE OF GRASSLAND CULTIVATIONS IN COTTON ROTATIONS.

W. G. WELLS Director of Cotton Culture.

THE suitability of the newly broken up cultivations out of the original virgin state for profitable cotton production has been previously pointed out. The value of cultivations out of grasslands, as a whole, has also been studied carefully in recent years, and it would appear that substantial benefits are to be gained on most of the cotton soils of the State where cotton is grown in rotation with grasses of sufficient age of establishment.

Benefits Obtained from Grassland Cultivations.

The benefits that may be expected from growing cotton in rotation with grassland cultivations may be grouped under the general headings of increased yield per acre, improvement in quality of lint, and a reduction in the cost of production.

It has been ascertained in several seasons that new cultivations out of the original virgin state usually produce heavier yields of lint cotton than do adjacent cultivations on which crops of cotton have been grown for more than five years in succession. Gains varying from 50 to 735 lb. seed cotton per acre have been realised in experiments and also in demonstrations with farmers. It seems definite, therefore, that the newer cultivations on a wide range of soil types are more suitable for cotton production under the various climatic conditions that may be expected in the main cotton-growing districts of the State.

Experiments at the Cotton Research Station and results obtained by farmers indicate that if Rhodes grass is grown for a couple of seasons on the old cotton cultivations increased yields of cotton may also be expected during at least the first two crops grown following the ploughing of the Rhodes grass. This appears to hold true for either wet or dry seasons, if the cotton is planted in October and November. Later plantings than this may not realise any gain from the rotation, especially

on the softwood scrub soils which are usually of a rather high nitrate content, and therefore tend to promote rank growth of plant in late sown crops.

Some increase in yield may be obtained occasionally where cotton is planted following grassland that has resulted from an old cotton cultivation being allowed to revert back to grass. This practice is not recommended, however, for usually on the old cultivations in the first few seasons that they are not cultivated very heavy weed growth occurs before the native grasses become established sufficiently to smother most of the weeds. Such grasses are also of the rather quick-growing type, and therefore do not produce such a lasting beneficial effect as does a vigorous grower like Rhodes grass. In addition to this, the excessive growth of weeds in the first season after cultivation has ceased, infests the soil with such a seeding that there are always sufficient weeds to compete successfully with the grasses in following seasons. The subsequent weed growth amongst the cotton crops following the ploughing of the grass may thus be as heavy as where successive crops of cotton have been grown.

Indications have also been observed that the growing of cotton on the newer cultivations increases the chances of obtaining lint of higher quality than may be realised on adjacent older cultivations. In an experiment carried out at the Cotton Research Station in 1933-34 on two-year, five-year, and nine-year old cultivations there was a general tendency in five varieties, covering a wide range of types, with the exception of the least drought-resistant variety, to produce lint of better grade, less spot, and longer fibre on the newer cultivations. In the following season on the same soils, which were then in their third, sixth, and tenth year of cultivation for cotton, out of the virgin grassland condition no significant differences were observed in respect to the fibre characters just mentioned. The season was wet during the first half, but very dry in the second, which may possibly have accounted for the levelling influence. There was, however, a marked increase in percentage of lint obtained in favour of the three-year-old cultivation, as well as more lint per seed.

Reducing the Cost of Production.

Growing-cotton on the newer cultivations not only tends to reduce the cost of production through the increase of yield obtained in many seasons, but the actual cultural expenses are lessened by the reduction of the number of cultivations required to keep the fields clean in the first three or four seasons after they are brought under crop. Weed and grass growth is less and the surface does not compact with the occurrence of heavy storms, so it is not necessary to cultivate so often. Sufficient cultivations should be given, however, to keep down weed growth, particularly pig weed, for this will increase very quickly if allowed to seed, and will reduce appreciably the number of years free of high cultivation costs.

A rotation of three or four years of Rhodes grass and then cotton seems also to reduce cultivation costs, provided the seed bed is well harrowed before the cotton is planted and a further cross harrowing is given when the cotton seedlings are 3 to 4 inches tall. Growers have advised that where cotton is grown in rotation with Rhodes grass, and given early cultural treatment as just described, less cultivation is required than where cotton is grown on the old cultivations for several years in succession.

The Explanation of the Increase in Yields.

The explanation of the increase in yields obtained where cotton follows grassland may be bound up in several factors, but the outstanding ones seem to be that in the newly broken up grassland the ratio of carbon to nitrogen is more suitable for cotton production, there is less production of nitrate nitrogen, and there is better penetration of storm rains. The ratio of carbon to nitrogen in a soil has a very important effect on the fruit production of a plant, the favourable ratio varying with different crops. Cotton appears to be very sensitive to this factor, and under Queensland conditions requires a wide ratio. Carbon is the base product of organic matter, such as the roots and leaves of plants, grasses, &c. When organic matter is ploughed into the soil the various bacteria start the process of decomposition, and in the course of this work the plant food nitrogen is evolved as nitrate-nitrogen, the soluble form taken up by plant life. Cultivation and the further ploughings with each season's preparation of seed beds aerate the soil and thus provide suitable conditions for the continued decomposition of the organic matter until eventually it is depleted seriously—the rate depending to a large extent on the number of bacteria in the soil and the period of favourable temperatures and moistures experienced.



PLATE 34.

Sow Rhodes grass on the old fertile cotton cultivations. Excellent grazing will be provided for both horses and cattle—the protein content of the grass at hay stage being around 8 to 11 per cent. in the first two seasons of growth, while yields up to 2 tons of dry hay per acre may be realised. Two or three years' growth of Rhodes grass restores the state of the old cultivation sufficiently to allow of the production of profitable yields of cotton under conditions at all favourable.

Grasslands Have Low Nitrate Content.

The various grass crops are heavy feeders of nitrate-nitrogen, and usually in the cotton districts of this State soil samples taken in either virgin grassland or sown Rhodes grassland seldom yield more than a trace of nitrate-nitrogen unless in very fertile alluvial soils. With three or four successive seasons of cotton cultivation the nitrate content of the same soil, expressed as parts per million parts of soil, may rise most appreciably, depending on the time of season in which the samples are taken—the nitrate content usually being much higher in the cotton soils during the summer season November to March. The results obtained at

the Cotton Research Station in the midst of a very dry November in the 1935-36 season in a series of comparable soils illustrate nicely the effect of cultivation on an alluvial fertile clay loam, the samples being of the first 6 inches of soil, and the cultivations having four weeks' old cotton:—Grassland—trace; first year cultivation—seven parts of nitrate-nitrogen per million parts of soil; and eleven-year-old cultivation—13 p.p.m. In the same season, on other more fertile alluvial clay loam at the Cotton Station eleven-year-old cultivation, which had produced several crops of cotton and was in cotton for the fourth successive year, contained 22 p.p.m. in the first 6 inches at the same date, and two months later at midseason during optimum conditions reached around 40 p.p.m.

The Effect of a High Nitrate Content in Cotton Soils.

The effect of a high nitrate content in a soil, particularly the upper 6 inches of it, is to cause fairly rapid growth of plants if ample moisture is available. This is especially true of the cotton plant, and observations over several years have indicated that on old alluvial cultivations of high nitrate content there is always a tendency for the cotton plant to make rapid development, which may result in a rank growth, particularly if an insect attack destroys many of the flower buds or bolls just prior to a wet period. The flower buds and bolls utilise much of the uptake of nitrates, and when they are destroyed the nitrates stimulate a big growth of roots, which in turn effect a greater uptake of nitrates, thus causing the very rank development of plant often seen in wet seasons on old cultivations, especially where severe corn-ear worm attacks have been experienced. Such rank development seldom occurs in early planted cotton following grassland, for the lower nitrate content of such soils does not stimulate excessive growth. The result is that when the insect attack ceases, a new crop of squares is formed quickly if ample moisture is available.

Not only does the rapid increase of nitrates often have a detrimental effect on yield of the cotton plants, but the decomposition of the organic matter in the soil is hastened, which materially affects the physical condition, particularly the heavier clay types. In such soils organic matter is necessary to keep the fine clay particles from consolidating to such an extent that the surface layer of a cultivation sets into a nearly impervious condition following any hard, beating storms. Where successive crops of cotton are grown on the same site for several seasons this condition is reached in a few years, as is shown clearly in soil moisture determinations made in an experiment carried out at the Research Station to demonstrate this point. In the 1933-34 season a study of the rate of penetration of a continuous rain lasting over twenty-five hours and yielding 2·46 inches demonstrated that fifteen hours after the rain stopped, in a nine-year-old cultivation of a clay loam type on which mostly cotton had been grown, only 35 per cent. of the total precipitation had penetrated into the first 18 inches of soil, with most of the gain in the upper 6 inches. On a similar soil type in the first season of cultivation out of the virgin country condition 74 per cent. of the rain had penetrated into the first 18 inches of soil.

Conclusion.

It can thus be seen that farmers should grow their cotton crops in rotation with grassland. Where such a system is practised the crop is grown on soil which has a suitable carbon-nitrogen ratio for the

production of good yields of cotton and a physical condition that allows of the obtaining of a high degree of efficiency of penetration of even storm rains. In addition to these factors, the grassland rotation tends to suppress weed growth. The net result is the obtainment of an increased yield of lint per acre, an improvement of quality, and a marked reduction in cost of production, both through increased yield and lessened cultivation costs.

AGRICULTURE ON THE AIR.

Radio Lectures on Rural Subjects.

Arrangements have been completed with the Australian Broadcasting Commission for the regular delivery of further radio lectures from Station 4QG, Brisbane, by officers of the Department of Agriculture and Stock.

On Tuesday and Thursday of each week a ten minutes' talk, commencing at 7.5 p.m., will be given on subjects of especial interest to farmers.

Following is the list of lectures for July and August, 1936:—

SCHEDULE OF LECTURES

BY OFFICERS OF THE DEPARTMENT OF AGRICULTURE AND STOCK, RADIO STATION 4QG, BRISBANE (AUSTRALIAN BROADCASTING COMMISSION).

Thursday, 2nd July, 1936.—"Dategrowing in Queensland," Mr. H. J. Freeman, Senior Instructor in Fruit Culture.

Tuesday, 7th July, 1936.—"Interpretation of Labels attached to Stock Foods," Mr. R. A. Taylor, Inspector and Examiner, Fertilizers Branch.

Thursday, 9th July, 1936.—"The Giant Toad," Mr. A. F. Bell, M.Sc., Assistant Director, Bureau of Sugar Experiment Stations.

Tuesday, 14th July, 1936.—"Amended Regulations of the Dairy Produce Acts," Mr. G. B. Gallwey, Inspector of Accounts, Dairy Branch.

Thursday, 16th July, 1936.—"The Breeding of New Cane Varieties," Dr. H. W. Kerr, Director, Bureau of Sugar Experiment Stations.

Tuesday, 21st July, 1936.—"The Use of Drugs in the Treatment of Parasitic Worms," Dr. F. H. S. Roberts, Entomologist and Parasitologist.

Thursday, 23rd July, 1936.—"The Production of Choice Quality Cream," Mr. O. St. J. Kent, Dairy Research Laboratory.

Tuesday, 28th July, 1936.—"Fungi which Assist the Growth of Plants," Mr. H. E. Young, B.Sc.Agr., Assistant Plant Pathologist.

Thursday, 30th July, 1936.—"Herd Recording," Mr. L. Anderson, Dairy Instructor.

Tuesday, 4th August, 1936.—"A Plea for the Tree," Mr. J. F. F. Reid, Editor of Publications.

Thursday, 6th August, 1936.—"Timber Trees on the Farm," Mr. W. D. Francis, Assistant Botanist.

Tuesday, 11th August, 1936.—"Rotation of Crops." Mr. H. W. Ball, Assistant Experimentalist.

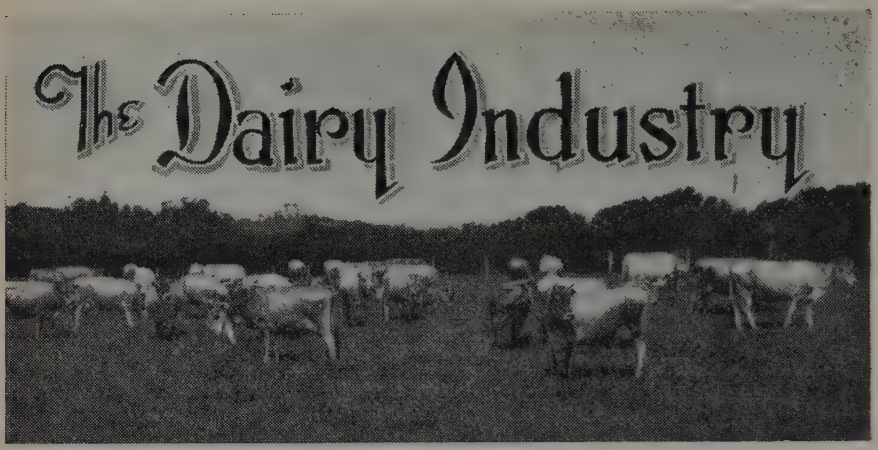
Thursday, 13th August, 1936.—"The Problem of Prices," Mr. J. F. F. Reid, Editor of Publications.

Tuesday, 18th August, 1936.—"Some Ways of the Soil," Mr. J. L. Foran, Analyst.

Thursday, 20th August, 1936.—"Some Plants Poisonous to Poultry and Pigs," Mr. C. T. White, Government Botanist.

Tuesday, 25th August, 1936.—"Our Debt to Denmark," Mr. J. F. F. Reid, Editor of Publications.

Thursday, 27th August, 1936.—"The Tick Fever of Cattle in Queensland," Mr. C. R. Mulhearn, B.V.Sc., Government Veterinary Surgeon.



THE ERADICATION OF TUBERCULOSIS FROM DAIRY HERDS.

J. C. J. MAUNDER, Government Veterinary Surgeon.*

TUBERCULOSIS of bovines is an infectious contagious disease caused by a germ, the tubercle bacillus, and transmissible from animals to man.

It is one if not the most serious of diseases found in dairy cattle, and unfortunately is one of the most common.

The importance of tuberculosis in dairy cattle can be discussed from two aspects—firstly, as it affects the health of live stock, and, secondly, the public health aspect.

In live stock tuberculosis is a chronic disease, usually fatal, and cannot as a rule be detected until infection has been present for some considerable period, sometimes years. Obviously, in considering methods of eradicating tuberculosis from a herd, accurate diagnosis of the disease is essential to ensure that in the process of eradication no diseased beasts are left behind and no animals free from tuberculosis culled from the herd. Several methods of diagnosis are available and are worthy of mention:—

1. The classical diagnostician in this country is the man who has been all his life among cattle and imagines he can pick them out easily from their general appearance, there being some supposed characteristics of a tubercular animal of which there can be no mistaking. Such method of diagnosis is dangerously unreliable, for many non-infected beasts will be labelled tuberculous while some tuberculous cattle will be passed over in the belief that they are healthy. When one realises that there are innumerable conditions that can make a beast unthrifty and miserable to behold, the danger of condemning all such as tubercular is obvious.
2. There are definite clinical signs of tuberculosis which, when observed in a beast, are sufficient justification for condemnation. Examples of such is the unthrifty beast affected with a

*From a broadcast talk from Radio Stations 4QG, Brisbane, and 4RK Rockhampton, by courtesy of the Australian Broadcasting Commission.

chronic, loose, or dirty cough, or the unthrifty beast showing definite enlargement of the lymphatic glands. It is necessary to point out that all enlargements of lymphatic glands are not tubercular, and this fact should be kept in mind when making a diagnosis. A typical symptom is the enlargement of the retro-pharyngeal lymphatic glands, exerting pressure on the larynx and causing the snoring respiration so often heard in infected herds. These are the commonest clinical signs, and time does not permit of further reference to this phase of the diagnosis.

3. Application of the tuberculin test is the most reliable method of diagnosing tuberculosis, and, at the present state of our knowledge of the disease, the one on which all eradication schemes must be based. For your information, I wish to state that the tuberculin test is applied with every confidence, and any beast reacting to the test can be slaughtered with the knowledge that it is infected.

4. Several laboratory methods of greater or lesser value may be employed in the diagnosis of the condition, these being in the nature of serological tests, use of experimental animals, and examination of excretions and milk samples from suspected animals. At present, however, such methods of diagnosis are of relatively small importance.

5. Indirect evidence often leads one to suspect the presence of tuberculosis in the dairy herd, and the most important example of this is the condemnation of pigs for tuberculosis. When a farmer rears pigs on his property, and on slaughter they are found to be tubercular, he may rest assured, in practically all cases, that tuberculosis exists in the dairy herd.

Having detected the presence of tuberculosis in the dairy herd by means of any one or more of the methods outlined, the next consideration is eradication and the establishment of tubercle-free herds.

Though much progress can undoubtedly be made towards the desired end by careful and regular examination of cattle, culling all beasts manifesting signs of tuberculosis, complete eradication, based on present knowledge, cannot be attained without the use of the tuberculin test.

Tubercle-free herds can be established by submitting the entire herd to the test, slaughter of reactors and disposal of the carcasses by burning, and retesting of the herd at least every twelve months.

The establishment of tubercle-free areas or shires is most desirable, and would entail the testing of all cattle within the area, destruction of reactors, and testing of all animals before introduction into the area.

It seems unlikely that wholesale testing of cattle and slaughter of reactors could be carried out on a voluntary basis, many farmers being unwilling and/or unable to risk the economic loss that would follow heavy condemnations. Therefore, it would appear that any comprehensive scheme for the eradication of tuberculosis must be founded on a basis of compulsory testing and compensation for diseased beasts.

I shall now discuss eradication of tuberculosis as it affects public health.

Human beings up to the age of about five years are definitely liable to infection with tuberculosis of bovine origin, and a certain percentage of tuberculosis in man has been found to be of bovine origin. The medium through which infection is transmitted is the milk, and in considering the problem of a pure milk supply the problem of eradication of tuberculosis from dairy herds supplying milk for human consumption is of paramount importance.

Many authorities consider that the only way to tackle this problem is by pasteurisation of all milk sold for human consumption, but it is rather significant that in all countries where pure milk supply is treated as a subject of major importance, active campaigns against tuberculosis are waged, and pasteurised milk is graded as a milk inferior to raw milk obtained from tubercle-free herds and produced under best conditions of sanitation and hygiene.

It is a mistake to think that pasteurised milk represents the ideal form of this necessary foodstuff, otherwise an ideal milk supply could be attained simply by pooling and pasteurising milk. Furthermore, pasteurisation fulfils its objective—namely, the destruction of all harmful bacterial contaminants—only so long as the processing is efficient.

There is no doubt that the most serious bacterial contaminants of milk, including tubercle bacilli, are not completely destroyed when the plant and/or supervision involved in the process of pasteurisation is inefficient. Therefore, where no official control or supervision of pasteurisation exists, the finished article may not be all that is claimed for it.

Do not imagine that I do not believe in pasteurisation of milk. I do, for it is a most valuable process whereby much milk that would otherwise be unfit for human consumption is rendered fit for human consumption, thereby avoiding economic loss.

I do, however, most definitely say that, in my opinion, raw milk produced from disease-free herds and handled under the best conditions of sanitation and hygiene is a definitely superior foodstuff to pasteurised milk produced from faulty herds and slovenly handled.

Unfortunately, it is most improbable that any great advances will be made towards our goal of the ideal milk supply until there exists a definite public demand for such a commodity. Producers of milk are conducting a business, and they cannot be expected to spend a great deal of money in an effort to put an improved article on the market unless the public is prepared to pay for it.

Therefore, it is up to the milk-consuming public to arouse itself from the present state of apathy, take an interest in the source of the milk supply, and create the demand for the article that can and should be supplied.

Just so long as the public fails to take an interest in pure milk and what it means, then just so long shall the efforts of science and legislation fail to accomplish the ideal milk supply, produced from tubercle-free herds, bred from tubercle-free stock in areas or shires free from tuberculosis.

A talk on tuberculosis in cattle would, at the present time, be incomplete without some reference to the work of Spahlinger, and it may not be the dream of an idealist to visualise a future where eradication of tuberculosis is based on the culling of clinically affected animals,

the remainder being treated with protective or even curative doses of a vaccine prepared along the lines suggested by Spahlinger.

Unfortunately, even though it is possible that Spahlinger may be right and his critics wrong, much work remains to be done before his work could be applied in the realms of everyday practice.

Meanwhile, we must adhere to our powers of observation and the tuberculin test to eradicate tuberculosis from our dairy herds.

It is essential that we realise that the eradication of tuberculosis is necessary to protect the human population against the well-recognised danger of tuberculous milk and the farmer from economic loss; that tuberculosis is a contagious disease, and as the country progresses, leading to more intensive farming and the increased contact of larger numbers of cattle running on smaller areas, then shall the incidence of tuberculosis increase, and the sooner the problem of its eradication is tackled the greater is the possibility of preventing a difficult problem assuming the proportions of a colossal one.

SOME ASPECTS OF MALNUTRITION IN DAIRY COWS.

By J. C. J. MAUNDER, B.V.Sc.*

IN dealing with this subject, I do not propose to describe any diseases caused by or attributable to malnutrition. I shall give you no details of rations to be fed to avoid malnutrition, but will endeavour to awaken you to the realities of malnutrition, for as soon as the dairy farmer begins to realise that malnutrition is a live and real thing, then shall the time be ripe to deal with the problem in greater detail.

Malnutrition can be defined as the inability of the animal to derive the raw materials necessary for maintenance of health and milk production from the available food supply.

The majority of holdings on which dairying is practised in Queensland do not satisfy the complete requirements of the dairy cow, and it is therefore necessary to supplement the grazing with hand feeding, or, on the better class of country, grazing on supplementary fodder crops such as oats, lucerne, cultivated grasses, &c.

Dairying "off grass" can only be successfully practised on the very best of our scrub lands, and to attempt it elsewhere is merely to court disaster, or, at best, a life of hard work and stagnation.

To understand the fundamentals of its requirements, it is essential to appreciate the fact that the modern dairy cow is an animal far removed from its wild prototype, and as careful breeding and selection has evolved an animal to produce a milk supply far in advance of that which nature intended, and as this factor of milk production is accentuated, so then is the necessity for supplementary feeding increased.

Nature intended cattle to roam at will with ample opportunity for selective grazing; they bred but once a year, and produced only sufficient milk to rear one calf. The modern dairy cow is confined to small areas, is expected to breed at any time of the year, having a regular oestrus cycle of approximately three weeks, and has to produce an amount of milk enormously greater than that necessary to rear a calf.

* In a broadcast talk from Radio Station 4QG Brisbane and 4RK Rockhampton.

It must be obvious that something far beyond the provision of natural pasture is essential to enable this modern dairy cow to perform the functions expected of her, and there is not the slightest doubt that the failure on the part of the farmer to recognise this state of affairs has paved the way for many of the troubles that beset stock to-day.

Let us consider, briefly, the requirements of a dairy cow.

Firstly, food stuffs must supply the energy necessary for the performance of all the vital functions, and this energy is, to a large extent, supplied by the grasses consumed in ordinary grazing.

To build up the tissues and to replace wear and tear, proteins are necessary, and, because of the additional protein requirements of the dairy cow to maintain the almost constant figure in the milk secreted, special efforts must be made to supply proteins in addition to that available in ordinary pasture plants.

A minimum mineral content of food stuffs is essential to maintain vital functions, and an additional supply of minerals is necessary to satisfy excessive demands of milk secretion and reproduction.

In determining a suitable ration to be fed to a dairy herd, it is not advisable to decide on a definite ration—so many pounds of this and so many pounds of that—rather decide on a basal ration, varying it according to the prevailing climatic and pastoral conditions, and amount of milk produced by the animal.

Where ample grazing is available, it would be unsound to feed large amounts of bulky fodders, chaff, hay, silage, &c. Protein concentrates are indicated such as the various meals, linseed meal, cotton seed meal, maize meal, cocoanut oil cake, plus small amounts of bulky food.

On the other hand, where grazing is poor, for example during winter, the ration must contain larger amounts of the bulky fodders necessary to distend the digestive tract, compensating for the defective grazing. In cold weather, with great loss of body heat, extra feed is needed to make good this loss and maintain body heat. This factor of additional feed to maintain body heat is a strong point in favour of rugging cattle in hard winters, the amount of feed thereby saved will amply repay the monetary outlay involved.

The mineral ration should remain constant throughout the season, varying only for individual cows according to the milk produced, as all our pastures tend to be deficient in essential minerals, particularly lime and phosphoric acid, irrespective of seasonal conditions.

With reference to minerals and the dairy cow, if you are to understand the particular requirements you must appreciate the following facts.

The percentage of minerals present in the milk secreted is almost constant. Take two similar cows producing equal amount of milk of equal quality, one getting a full mineral ration and the other a low mineral ration. Notwithstanding the difference in minerals supplied, the actual amount of minerals being secreted daily in the milk is approximately the same in both animals. Where then does the mineral content of the milk come from in the case of the cow receiving a low mineral ration; it is actually derived from the reserves stored in the tissues of the animal. It has been shown in one particular case, that a cow was secreting in the milk just five times the amount of lime present in the daily ration.

It is easy to imagine to what extent this animal's lime reserve would be drawn upon throughout the lactation period. This sort of thing cannot go on, and the inevitable happens in the fundamental breakdown of the animal, manifested by one or more of the particular conditions peculiar to dairy cattle.

I assure you, that even on the best of country where supplementary feeding has not been necessary, the feeding of minerals must be practised if the maximum efficiency is to be obtained.

The most important function of the dairy cow is that of reproduction, and if a cow fails in this obligation, she no longer becomes profitable, and must be culled.

Undoubtedly, a great economical loss is represented by the large number of dairy cows affected with temporary or permanent sterility. Remember my remarks pointing out the difference between the reproductive obligations of the undomesticated cow and those of our modern dairy cow, and you must realise that some particular attention is necessary if the unnatural demands of reproduction are to be fulfilled.

Undoubtedly many of the problems of sterility are directly associated with malnutrition, and the more readily the problem of malnutrition and its relation to regular reproduction is appreciated, the more successfully are farmers likely to combat sterility.

My final reference is to dry stock—remember that although the dry cow is not producing any milk, she is providing or attempting to provide sufficient nutrition to an embryo calf in the final stages of its uterine life, and considerable demands are therefore made on the maternal reserves.

I ask, therefore, that the dry cows receive the attention that is their due, when the problem of malnutrition is receiving the consideration that is essential for the successful practise of dairy farming.

OFF FLAVOURS OF MILK AND CREAM.

E. B. RICE, Dairy Research Laboratory.

THE flavour of milk and cream may be influenced by any pathological or abnormal physiological condition of the animal itself.

Mammitis Milk.

Disturbances of the udder causing inflammation, referred to as mammitis or garget, usually give a salty taste to the milk. The causative bacteria often prevent the normal souring of the cream separated from such milk, and it acquires a disagreeable flavour. Mammitis milk is also undesirable for cheese-making, owing to its slow coagulation with rennet.

Colostrum Milk.

The milk from cows for the first week after parturition, known as the colostrum, has a bitter taste and a strong odour, and is sometimes classed by graders as unclean, the term meaning that it does not possess the desirable taste of normal, cleanly produced milk. The cream from the colostrum also has a sickly, albuminous flavour, and the blending of it with other cream results in the whole delivery being graded lower

than choice quality by the factory. Colostrum is also quite unfit for human consumption or for cheese-making purposes. The protein lacto-globulin, which is present to the extent of only 0.3 per cent. in normal milk, varies in the colostrum from 16.0 per cent. immediately after calving, to 3.0 per cent. seventy-two hours later, and only reaches the usual amount in the milk after about seven days. It is because of the clotting of this protein upon heating that colostrum milk cannot be boiled. The function of the colostrum is of the utmost importance for the welfare of the calf during the first days of its existence, acting as a protection against certain bacterial invasions which might otherwise prove fatal.

Effect of Period of Lactation.

Milk from cows late in the lactation period possesses a bitter or salty taste, which is due to the effect of the salt content of the milk not being masked by the relatively low percentage of milk sugar at this stage. Similarly, owing to a drop in the sugar content, and a rise in the salt ratio, milk produced during a prolonged period of drought may be salty in taste.

Rancid Milk.

Certain animals habitually yield milk which turns rancid. As the principle causing the rancidty attacks the fat of any other milk with which that from affected cows is mixed, it is sometimes found necessary in countries where milk is produced for critical local markets, to remove such animals from the herd. Pasteurisation arrests the active principle, but this is hardly practicable or economical under the ordinary circumstances in which milk is handled.

Absorbed Flavours of Milk and Cream.

Milk fat, in common with other fats, but to a more marked extent, will readily absorb odours from its surroundings. Among the various sources of these flavours, the following are the more common.

Disinfectant Flavours.

Chemical odours, chief amongst which are the flavours derived from the use of strongly smelling carbolic disinfectants, about the dairy or for cleaning the animals' udders often taint the cream supply. Where a disinfectant is required for cleaning utensils or washing the udders, the chlorine compounds, such as bleaching powder, are more serviceable, for in addition to possessing a strong germicidal action, they will not leave any taint if made up in the proper strength. A dilute solution of condy's fluid is another useful and popular disinfectant for cleaning cows' udders before milking.

Other Common Absorbed Taints.

Fume or gasoline flavours in milk and cream arise frequently from the exhaust of a separator engine blowing back into the separator room. Odours of kerosene, petrol, paint, or the smoke from the fire under the dairy boiler, are sometimes encountered.

Musty or mouldy flavours, caused through storing cream in ill-ventilated, damp cellars, were of common occurrence some years ago, but are practically unknown nowadays.

The storage of cream, butter, or other milk products near fish, bacon, or any other odiferous foods in the home ice chest, frequently leads to spoilage by the absorption of the odour from the surroundings.

Tobacco Fertilizer Trials.

Subjoined is a report on tobacco fertilizer trials conducted in North Queensland during the 1934-35 season by Mr. W. J. Cartmill, B.Sc., Bureau of Tropical Agriculture, Department of Agriculture and Stock.

FOLLOWING on the work initiated during the 1933-34 season in the Mareeba district of conducting a series of fertilizer trials laid out on modern plans which permit of a statistical analysis of the results the scope of the work was extended, and a number of trials was conducted in the principal tobacco districts of the State. An effort was made to establish trials on all the principal soil types in each district. These districts comprised the Cairns hinterland (Mareeba and Dimbulah), Woodstock, Charters Towers, Bowen, Mackay, and Miriam Vale. Owing to the droughty conditions which prevailed in the Woodstock and Bowen districts until late in the season, and the lengthy intervals of hot weather between the subsequent falls of rain, it was found impracticable to establish the trial satisfactorily in these two districts. In the other northern districts dry conditions obtained for a time in the early part of the season, but with the advent of more favourable conditions later the trials were established satisfactorily.

Practically all the tobacco grown in this State is of the bright flue-cured variety such as is most easily produced on infertile sandy soils. Consequently the soils of the tobacco districts do not show a wide variation in type. They are mostly infertile sands of various textures and colours, and are mostly granitic in origin. The average depth of the top soil is about 10 inches; the subsoil in some cases is of considerable depth, while in others decomposed rock is struck at fairly shallow depth. Where alluvial sands occur they are in favour; as a rule they are medium to dark grey, fine-textured sands of good depth.

In the series of trials conducted during the past season concentration was made on phosphate trials. Most of our tobacco soils are very deficient in, in fact almost devoid of this plant food. As was indicated in the first series of trials (1933-34 season) on these soils, a very pronounced response is given to applications of phosphate, while practically no growth is made, other things being equal, when no phosphate is applied.

In planning trials of this nature one has to keep in mind that, in the case of tobacco, a balance between quantity and quality is the aim. Phosphates exert a pronounced influence on both, but the minimum amount required to produce optimum growth may not be that required for optimum quality. So that whereas no significant differences in yield might be obtained with applications of different quantities of, say, superphosphate, the differences in the quality of the resultant leaf might be pronounced. These expectations have been borne out in the results of these trials.

The trials were laid out on a uniform plan of a 5 x 5 Latin square of 1/50-acre plots, making the total area of each trial $\frac{1}{2}$ acre. The five treatments contained equal quantities of nitrogen and of potash, but different quantities of phosphate, and were as follows:—

Nitrogen.

This was applied to all plots at the rate of 30 lb. per acre of nitrogen, of which one-half was derived from dried blood at the rate

of 120 lb. per acre, and one-half from nitrate of soda at the rate of 97·5 lb. per acre.

Potash.

This was applied to all plots at the rate of 30 lb. per acre of K_2O derived from 62·5 lb. per acre of sulphate of potash.

Phosphate.

Treatment No. 1.—1P—25 lb. per acre of P_2O_5 derived from 125 lb. per acre of superphosphate.

Treatment No. 2.—2P—50 lb. per acre of P_2O_5 derived from 250 lb. per acre of superphosphate.

Treatment No. 3.—3P—75 lb. per acre of P_2O_5 derived from 375 lb. per acre of superphosphate.

Treatment No. 4.—4P—100 lb. per acre of P_2O_5 derived from 500 lb. per acre of superphosphate.

Treatment No. 5.—5P—125 lb. per acre of P_2O_5 derived from 625 lb. per acre of superphosphate.

The quantities of nitrogen and potash used were considered to be liberal but not excessive amounts as judged by experience of the requirements of most of our tobacco soils. The phosphoric acid was supplied as superphosphate, which is considered to be the most suitable form of phosphate to use for tobacco in these soils. It is hoped, nevertheless, to conduct a series of trials at a later date to determine the relative merits of phosphate applied in different forms.

The quantity of nitrogen used was determined on after a consideration of several factors, and it was finally considered that the quantity used would be likely to give the most satisfactory balance between yield and quality on most of the plots, the soils in nearly all cases being infertile sands. It is conceivable that, by using a smaller quantity of nitrogen, the proportion of bright leaf from the plots treated with the lower quantities of phosphate would have been increased, but the average yields probably would have been lowered, though the same relative differences in yield would most likely have persisted. Experience of the crops produced on the sandy soils as occur in most of our tobacco-producing districts shows that as a rule with small applications of nitrogen such as are added to the soil with moderate applications of the proprietary mixtures that are mostly used the resultant yield is not high, and the leaf, though bright, is usually small in size and often lacks body and texture, and, all things considered, returns but a meagre profit to the grower. The tendency now is to aim at producing a higher yield of good quality bright mahogany leaf and, consequently, less of the thin-bodied yellow (lemon-coloured) leaf. As well as a change in cultural operations, greater quantities of fertilizer are being used, and the practice seems to be a profitable one.

The quantities of the various fertilizers required for a plot were weighed and mixed together a short time prior to their application in the field. To ensure a uniform application the quantity required for each row was measured out in cylindrical vessels. Before applying the fertilizer the soil was partly ridged up. The fertilizer was then distributed by hand in a broad strip along the middle of the ridges and subsequently covered by and mixed with the soil by further ridging. The planting out was done by hand. The usual cultural practices as are ordinarily adopted by the grower were used during the growth of the crop.

The season just past is one that will go on record as being extremely dry in all the northern districts. Though the total rainfall for the season in the various districts is seemingly sufficient for the requirements of the crop it did not come at times when it would have been of most benefit, nor did it always fall in advantageous amounts. Transplanting operations were considerably handicapped by the absence of rain in the early part of the season. At that time, too, a moderate precipitation would usually be followed by a relatively lengthy period of hot, dry weather, which adversely affected the growth of the plants. In most districts the latter part of the season showed an improvement in conditions, but in one or two areas unfavourable conditions were maintained. In these areas the leaf either broke down physiologically or could not be cured to even a fair degree of quality.

In laying out trials on the modern plot arrangements and in all subsequent operations the greatest care has to be taken to ensure that reliance can be placed on the results obtained. It is essential to aim at getting significant differences between treatments; and these are not easily obtained when the experimental error is relatively large. In trials such as of phosphate or of potash a difference in fertilizer treatment may not cause any significant difference in yield, though the effect on quality may be marked. In such cases a statistical analysis of the quality of the leaf from the various plots would be desirable, but under the present arrangement of conducting these trials such detailed work is not practicable.

Causes that are difficult to control tend to increase the experimental error and so lessen the chances of obtaining significant differences. Chief amongst these are the depredations of insect pests and diseases which impair the growth and sometimes upset an even stand of plants. The weather plays a dominant part in determining yield and quality of leaf, and consequently the precision of an experiment is largely influenced by it. In this series of trials the stem borer was the greatest menace. In the northern districts, particularly, this pest was very severe, scarcely a plant escaping infestation. Its depredations were rendered doubly severe by being coupled with dry and hot weather conditions for a comparatively long period during the early stages of growth of the plants, so that they had little chance of making headway against the ravages of the pest. It was considered inadvisable at such times to use the practice frequently adopted of cutting back the plant and allowing a sucker to develop, for under the arid conditions prevailing there was a danger of bringing about the total destruction of the plant. However, with the advent of more favourable weather conditions later the plants made good development. Nevertheless, the delay in growth occasioned by this pest must reasonably be considered to have an adverse effect upon the yield and quality of the resultant crops.

One can understand, then, that because of pests and diseases and the vagaries of the weather the tobacco experimentalist receives many a setback, and that quite a few experiments are spoilt despite all care and attention. Deductions are drawn only from the most reliable results; and to be sure of these it is necessary to conduct a fairly large number of trials and to give each one proper care and attention. The co-operation of farmers is essential, and the public spirit of those farmers who have co-operated with this Department in this experimental work is much appreciated.

In selecting sites for these plots we aimed at choosing only land that had been cropped with tobacco and that had been allowed to lie fallow or that had not been treated with fertilizers for a year or two previous to the trials, as, for obvious reasons, such land would be in the best state for experimental work. However, most of our tobacco areas have been developed only in recent years, and some farmers have only recently attained a cleared area in excess of their annual requirements, so that the sites sought after could not in all cases be obtained. As the soils are mostly infertile sands, virgin areas were considered the best alternatives.

That the proper use of fertilizers is essential to produce tobacco of good quality is fundamental; and the best and most reliable way of determining the requirements of any particular soil is by conducting a series of experiments based on sound scientific principles, so that the degree of accuracy of the experiment can be estimated. At times it is found that the experimental error is too large to enable conclusions to be drawn from the results of the experiment. In such cases the causes are usually outside the control of the operator. A percentage of the experiments can be expected always to yield inconclusive results, and to make up for these there is a need to increase the numbr of plots. If only one plot is established on each soil type it is to be expected that the information sought after concerning a type will sometimes not be obtained in the particular series of trials. It is also desirable to confirm results by duplicating plots. At least the experiment on each soil type should be duplicated, having the plots on locations not in close proximity. Then, too, only a small number of problems can be dealt with in one series of trials. A further increase in the number of trials would enable a larger number of problems to be dealt with and, consequently, final conclusions to be arrived at earlier. However, as the trials are managed at present, it would be impracticable to give an increased number of plots the attention they would require. Extra labour would have to be made available—labour that we could rely upon obtaining whenever it was required. What suggests itself as likely to be the most satisfactory arrangement would be to enlist the co-operation of tobacco associations and farmers, and obtain the necessary labour from the farmers themselves, preferably from the farms on which experiments are being conducted. Some basis of remuneration for the little extra care and attention it would be required to give to the plots could be decided upon. With some such scheme in operation we could hope to achieve more in a shorter time than what is likely under the present working arrangements.

The conducting of a series of green manurial trials in conjunction with these fertilizer trials is a matter which should be kept in mind. Most farmers appreciate the importance of green manures and grow some crop for this purpose. However, it would be an advantage if the relative merits of various crops were determined by experiments.

It is considered important that a number of laboratory investigations relative to these trials should be carried out also. Such investigations would probably be of considerable assistance in the interpretation of the results of field observations. Data relating to the hydrogen-ion concentration of the soils, their varying nitrate content, the carbon-nitrogen ratios, and moisture determinations should yield useful information.

Discussion and Interpretation of Results.

An examination of the results of the trials indicates that the higher applications of superphosphate have significantly increased the yield over that of the lower applications in several cases. The tendency is for the red and brown soils to show an increase in yield for applications of up to 75 lb. P_2O_5 (375 lb. superphosphate) per acre; beyond 75 lb. increases in yield are shown in some cases, but they are not significant.

The grey and light-coloured sands are not uniform in their behaviour. In some cases there is an increase in yield up to 75 lb. P_2O_5 per acre; while in others there is no further increase beyond 50 lb. P_2O_5 per acre.

The yields from the plots are in most cases fairly high. There is no doubt that the so-called dry season contributed somewhat to this result.

The quality of the leaf generally was good; nearly all of it could be classified amongst the various grades of bright mahogany. However, the superior quality of the leaf from the higher applications of superphosphate compared with that of the lower applications was a feature of the trials. Leaf from No. 1 treatment (25 lb. P_2O_5) invariably contained a smaller percentage of bright leaf than leaf from the other treatments, and was inferior in general qualities. Leaf from No. 2 treatment (50 lb. P_2O_5) showed an improvement on the former, but in most cases it was evident that a still further improvement was shown, in colour particularly, by the leaf from treatments 3, 4, and 5, representing 75 lb., 100 lb., and 125 lb., respectively, of P_2O_5 per acre. Between these there was not always a marked difference discernible by an examination of the bulks, but in some cases where the leaf was graded in detail it was found that treatments 4 and 5 each contained a higher percentage than treatment 3 of the higher-grade leaf. It was noticed that this further improvement was manifested particularly by leaf grown on red soil.

Yield and quality, therefore, show a similar correlation in respect of the amount of phosphoric acid supplied. Quality improves with increasing yield, so that when phosphoric acid is made the limiting factor the plant must have a supply of this sufficient to enable it to reach maximum development before the best qualities of the leaf are exhibited. However, it is noticed that a further improvement in quality is effected when the amount of phosphoric acid supplied is somewhat in excess of that required for maximum growth.

Assuming that sufficient potash is supplied for the normal requirements of the plant and that greater quantities do not materially affect the quality of the leaf, the indications of these trials are that, with nitrogen supplied at the rate of 30 lb. per acre in a mixture of equal parts, nitrogen for nitrogen, of s. nitrate and blood, the minimum of phosphoric acid for best results varies a little with the soil type, being less for most of the grey and light-coloured sands than for the red sands; however, in most cases 75 lb. P_2O_5 seems to be a fair average of the minimum requirements, but a larger quantity, especially on the highly-coloured soils, is beneficial. It can be stated, therefore, that a fertilizer supplying at least 80 lb. per acre of phosphoric acid should be used, while in the case of the red soils up to 90 lb. might be found more beneficial. Considering the fertilizer 4-12-6, which is the Departmental formula, it would appear that a good balance between yield and quality should be obtained on the light, infertile, sandy soils if

this is used at the rate of 700 to 750 lb. per acre. On the same basis a fertilizer of the 3-8-3 formula would require to be used at the rate of 1,000 lb. per acre. These applications are higher than most farmers have been using in the past.

Of course it is not possible to deduce from one series of experiments what fertilizers are most likely to give the best results. The experiments must be carried on over a period of years. Nevertheless, useful indications are often given from which recommendations can be made. Eventually one should be able to advise on the most economical management of the various soils.

In cases where it was found to be practicable the leaf from each of the five treatments was graded in detail. Information on the prices received for the various grades will be obtained later, and from these prices some indication of the economic values of the different fertilizer treatments can probably be deduced.

Rainfall Record of Mareeba District.

Month.	1934.		1935.	
	Points.	Average.	Points.	No. of Wet Days.
January	1,350	948	373	8
February	1,397	737	502*	7
March	1,451	696	855*	10
April	267	272	49	5
May	62	60	271	5
June	101	50	5	1
July	29	31	..	..
August	4	16	..	..
September	34	19	..	..
October	15	58	..	..
November	239	125	..	..
December	28	439	..	..

* From 10 to 12 inches fall over a period of four days from February 27th—March 2nd.

Rainfall Mackay and Miriam Vale Districts.

1934–35.	Mackay.		Miriam Vale.	
	Points.	Average.	Points.	Average.
November	338	299	763	285
December	207	729	635	586
January	434	1,448	847	989
February	1,659	1,139	580	883
March	520	1,181	202	486
April	317	1,239	295	334
May	1,080	371	204	203
June	68	265	27	285

Though affected a little early in growth by stem borers the plants subsequently made good, even growth on all plots. The leaf cured well, was, in general, of good size, body, texture, and colour. The leaf was graded, but details of prices received are not yet to hand.

TOBACCO EXPERIMENTAL PLOTS.

BOUNDY BROS., DIMBULAH.

Variety.—Cash.
Planted.—December.
Harvested.—May-June.
Soil.—Light pink, gravelly sand.
Subsoil.—Light red, sandy.

YIELDS :—Lb. of cured leaf per 1/50-acre plots.

2P 20·0	5P 23·1	4P 19·5	1P 20·8	3P 20·9
1P 17·4	4P 22·6	5P 20·2	3P 21·1	2P 18·3
3P 19·3	1P 15·8	2P 20·0	4P 23·6	5P 25·0
4P 18·9	2P 16·5	3P 22·0	5P 21·6	1P 17·9
5P 20·4	3P 23·7	1P 17·2	2P 19·9	4P 24·5

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Rows	4	10·73	..	..
Columns	4	18·37	..	..
Treatments	4	72·80	18·200	1·4507
Errors	12	45·38	3·782	·6651
Total	24	147·28	..	..

Standard error (5 plots) $= \sqrt{3{,}782 \times 5}$
$= 4{\cdot}3$
$= 4{\cdot}2$ % of mean yield.

SUMMARY OF YIELDS.

Treatments.	1P	2P	3P	4P	5P
Yield (cured leaf), lb per acre	891	947	1,070	1,091	1,103
Cured leaf, percentage mean yield	87·3	92·8	104·9	106·9	108·1

Discussion.

The yields from plots with applications of superphosphate of 375 lb. per acre (treatment 3) or greater are significantly greater than those from plots with lower applications. Applications greater than 375 lb. superphosphate per acre have caused no further significant increases.

SHAW AND O'BRIEN, DIMBULAH.

Variety.—Hickory Pryor.
Planted.—Fourth week in January.
Harvested.—June-July.
Soil.—Pink, sandy.
Subsoil.—Light red, sandy.

The quality of the leaf from this plot was spoilt by adverse seasonal conditions. The rainfall over the section of country where this plot was located was sparse and not well distributed. Though the plants made good growth the leaf broke down physiologically before it was mature, and it could not be cured to a good degree of quality.

YIELDS :—Lb. cured leaf per 1/50-acre plots.

2P 19·6	5P 23·6	4P 20·3	1P 22·9	3P 24·4
1P 19·6	4P 21·0	5P 19·6	3P 22·4	2P 21·4
3P 22·1	1P 21·0	2P 19·7	4P 19·4	5P 21·9
4P 20·3	2P 23·2	3P 21·9	5P 22·1	1P 19·7
5P 20·6	3P 19·1	1P 19·0	2P 20·8	4P 25·3

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Rows	4	6·67	..	..
Columns	4	19·12	..	..
Treatments	4	6·90	1·725	..
Errors	12	37·95	3·162	..
Total	24	70·64	..	..

Summary of Yields.

Treatments.	1P	2P	3P	4P	5P
Yield (cured leaf), lb. per acre	1,022	1,047	1,099	1,063	1,078
Cured leaf, percentage mean yield	96·2	98·6	103·5	100·1	101·5

Discussion.

The effect of treatment is not significant in this trial.

GODFREY AND MAY, CHEWKO, MAREEBA.

Variety.—Cash.

Planted.—20th November, 1934.

Harvested.—March-April-May.

Soil.—Grey, sandy.

Subsoil.—Yellowish-grey, sandy.

This trial was originally designed for a 5 x 5 Latin square. However, the planting up of the block was not completed in one operation, and one range of plants was not satisfactorily established. Consequently it has been treated as a 5 x 4 randomised block.

Yields :—Lb. cured leaf per 1/50-acre plot.

N2PK 13·1	N5PK 13·4	N4PK 14·6	N1PK 11·9	N3PK 11·0
N1PK 8·1	N4PK 13·6	N5PK 11·9	N3PK 15·0	N2PK 14·1
N3PK 11·4	N1PK 8·3	N2PK 12·0	N4PK 12·9	N5PK 15·5
N4PK 12·8	N2PK 12·9	N3PK 12·8	N5PK 12·1	N1PK 10·3
A	B	C	D	E

Analysis of Variance.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Blocks	3	1·86	0·62	..
Treatments	4	39·25	9·813	1·1419
Errors	12	30·16	2·513	0·4607
Total	19	71·27	..	..

Standard error (4 plots) = $\sqrt{2 \cdot 513 \times 4}$
= 3·2
= 6·5 % mean yield.

Summary of Yields.

Treatments.	1P	2P	3P	4P	5P
Yield (cured leaf), lb. per acre	483	651	628	674	661
Cured leaf, percentage mean yield	77·9	105·2	101·3	108·8	106·8

Discussion.

The yield from plots receiving treatment No. 2 (250 lb. superphosphate per acre) is significantly greater than the yield from those receiving the lower application of 125 lb. superphosphate per acre (treatment No. 1). Higher applications of superphosphate have made no further significant difference to the yield.

F. RAYMENT, CHEWKO, MAREEBA.

Variety.—Hickory Pryor.

Planted.—First week in December.

Harvested.—April-May-June.

Soil.—Grey, sandy.

Subsoil.—Brownish-yellow sand.

The plants on nearly all of the plots made good growth. The yields of some of the individual plots were unusually high. However, growth in patches was irregular, due partly to nematode infestation and partly to adverse location, which, no doubt, have interfered with the effect of treatment.

The quality of the leaf was good. Statistics of the various grades and prices received are not yet to hand.

YIELDS :—Lb. cured leaf per 1/50-acre plot.

2P 26·9	5P 31·8	4P 29·4	1P 28·3	3P 38·8
1P 25·9	4P 28·0	5P 28·0	3P 28·9	2P 37·4
3P 19·4	1P 22·5	2P 23·1	4P 30·0	5P 29·7
4P 24·5	2P 25·9	3P 21·8	5P 28·1	1P 27·0
5P 15·3	3P 18·0	1P 14·3	2P 19·6	4P 21·1

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Rows	4	546·52	..	..
Columns	4	222·01	..	..
Treatments	4	34·30	8·575	1·0744
Errors	12	56·67	4·722	·7761
Total	24	859·50	..	..

SUMMARY OF YIELDS.

Treatments.	1P	2P	3P	4P	5P
Yield (cured leaf), lb. per acre	1,180	1,329	1,269	1,330	1,329
Cured leaf, percentage mean yield	91·7	103·2	98·6	103·3	103·3

Discussion.

There is a tendency towards increased yields from the higher applications of superphosphate, but on the analysis of variance the effect of treatment is not significant according to the "Z" test in the 5 per cent. table.

DICKIE AND BOWER, PADDY'S GREEN, MAREEBA.

Variety.—Cash.
Planted.—January (second week).
Harvested.—April-May-June.
Soil.—Red sandy.
Subsoil.—Red sandy.

For the first two months of growth the development of the plants on this trial was retarded by the dry conditions. Consequently, when the plants reached maturity the leaf was inclined to be thin in body. However, rain fell after two harvests had been made, and the remaining leaf improved considerably in body and texture. The resultant yields were higher than had been anticipated. The different applications of superphosphate have made no significant difference to the yields, though probably the dry conditions were not favourable for the manifestations of their full effects. The quality of the leaf was good. The leaf was graded in detail, treatments 4 and 5 showing greater percentages of high grade leaf than the other treatments.

YIELDS :—Lb. cured leaf per 1/50-acre plot.

2P 14·6	5P 16·1	4P 22·6	1P 15·6	3P 17·8
1P 10·6	4P 18·0	5P 20·9	3P 18·2	2P 19·3
3P 13·1	1P 19·6	2P 17·6	4P 16·3	5P 17·1
4P 16·5	2P 17·3	3P 19·8	5P 19·6	1P 20·2
5P 18·6	3P 19·1	1P 18·2	2P 18·9	4P 19·4

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Rows	4	16·76	..	..
Columns	4	73·96	..	..
Treatments	4	10·21	2·55	..
Errors	12	53·29	4·44	..
Total	24	154·22	..	..

Summary of Yields.

Treatments.	1P	2P	3P	4P	5P
Yield (cured leaf), lb. per acre	842	877	880	928	923
Cured leaf, percentage mean yield	94·6	98·5	98·9	104·3	103·7

Discussion.

The effect of treatment is not significant in this trial.

T. CRAIG, MIRIAM VALE.

Variety.—Cash.

Planted.—29th and 30th November.

Harvested.—February-March.

Soil.—White coarse sand.

Subsoil.—White coarse sand and partly decomposed granite.

Wet conditions for seven or eight weeks after planting caused a rapid growth and early maturity. The colour and general qualities of the leaf were good, though the size was inclined to be small.

Yields :—Lb. cured leaf per 1/50-acre plot.

3P 9·4	2P 8·4	5P 10·6	1P 9·3	4P 9·6
1P 8·6	3P 9·1	4P 10·6	5P 12·2	2P 10·9
4P 11·1	5P 8·7	2P 11·6	3P 14·4	1P 10·4
5P 10·8	4P 11·4	1P 12·6	2P 17·9	3P 13·9
2P 14·1	1P 10·9	3P 16·3	4P 20·9	5P 16·6

Analysis of Variance.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Rows	4	129·334	..	..
Columns	4	77·834	..	..
Treatments	4	19·882	4·996	·8043
Errors	12	16·096	1·341	·1467
Total	24	243·146	..	..

Standard error (5 plots) = $\sqrt{1·341 \times 5}$
= 2·6
= 4·3% of mean yield.

Summary of Yields.

Treatments.	1P	2P	3P	4P	5P
Yield (cured leaf), lb. per acre	518	629	631	636	589
Cured leaf, percentage mean yield	86·2	104·7	105·1	105·9	98·1

Discussion.

The yield from plots receiving 250 lb. superphosphate per acre (No. 2) is significantly greater than the yield from the plots receiving the lower application of 125 lb. superphosphate per acre (No. 1).

Higher applications of superphosphate have made no further significant difference to the yield.

B. ANDERSON, MIRIAM VALE.

Variety.—Cash.

Planted.—1st and 2nd December.

Harvested.—February and March.

Soil.—White sand—coarse.

Subsoil.—White coarse sand with decomposed granite.

Rapid growth was brought on by wet conditions in December and January. The leaf had a tendency to mature early. The quality of the leaf was good, although in size it was not as large as can be expected by reason of a steadier growth of the plants.

YIELDS :—Lb. cured leaf per 1/50-acre plot.

3P 10·9	2P 11·4	5P 15·4	1P 10·7	4P 13·9
1P 10·1	3P 9·0	4P 15·1	5P 14·6	2P 11·2
4P 11·3	5P 15·9	2P 12·4	3P 12·1	1P 11·9
5P 14·6	4P 17·4	1P 9·7	2P 13·4	3P 17·0
2P 10·3	1P 13·3	3P 13·7	4P 15·5	5P 16·2

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Rows	4	19·972	..	..
Columns	4	18·892	..	..
Treatments	4	66·960	16·740	1·4089
Errors	12	34·476	2·873	·5277
Total	24	140·300	..	..

Standard error (5 plots) = $\sqrt{2 \cdot 873 \times 5}$.
= 3·8
= 5·8% of mean yield.

SUMMARY OF YIELDS.

Treatments.	1P	2P	3P	4P	5P
Yield (cured leaf), lb. per acre	557	587	627	732	767
Cured leaf, percentage mean yield	85·2	89·8	95·9	111·9	117·3

Discussion.

There is a progressive increase in yields with increasing applications of superphosphate, but the difference in yields between consecutive treatments is not significant. However, the yields from treatments 4 and 5 are significantly greater than the yields from treatments 1 and 2.

R. J. AND C. A. ATHERTON, KOUMALA.

Variety.—Warne.

Planted.—27th and 28th December.

Harvested.—March-April.

Soil.—Light grey, fine textured sand.

Subsoil.—Light grey sand, with decomposed granite.

Good even growth was made in all plots. The leaf was not graded, but was reported to be of good quality generally.

YIELDS :—Lb. cured leaf per 1/50-acre plot.

4P 23·0	1P 17·0	5P 24·0	2P 23·3	3P 30·3
2P 22·8	5P 25·3	4P 25·8	3P 19·5	1P 22·0
1P 27·5	3P 30·0	2P 23·5	5P 27·8	4P 22·0
3P 27·0	2P 24·5	1P 21·5	4P 23·5	5P 20·0
5P 19·5	4P 27·5	3P 25·0	1P 18·5	2P 22·0

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ loge (Mean Square).
Rows	4	40·338	..	..
Columns	4	15·330	..	..
Treatments	4	68·226	17·056	·2670
Errors	12	161·272	13·439	·1478
Total	24	285·166	..	..

Summary of Yields.

Treatments.	1P	2P	3 P	4P	5P
Yield (cured leaf), lb. per acre	1,065	1,161	1,318	1,218	1,166
Cured leaf, percentage mean yield	89·8	97·9	111·1	102·7	98·3

Discussion.

There is a tendency for the results to be in accordance with those found in other trials—viz., an increased yield with the higher applications of superphosphate. Nevertheless, no deductions can be drawn as the effect of treatment is not significant.

J. STOKER, CHEWKO, MAREEBA.

Potash Trial.

The treatments used were as follows:—

Treatment No. 1.—1K.: 25 lb. per acre of sulphate of potash.—12 lb. per acre of K_2O.

Treatment No. 2.—2K.: 50 lb. per acre of sulphate of potash.—24 lb. per acre of K_2O.

Treatment No. 3.—3K.: 75 lb. per acre of sulphate of potash.—36 lb. per acre of K_2O.

Treatment No. 4.—4K.: 100 lb. per acre of sulphate of potash.—48 lb. per acre of K_2O.

Treatment No. 5.—5K.: 125 lb. per acre of sulphate of potash.—60 lb. per acre of K_2O.

In addition all plots received an application of nitrogen and phosphate as follows:—

Nitrogen equivalent to 30 lb. per acre of nitrogen, half of which was derived from dried blood at the rate of 120 lb. per acre, and half from nitrate of soda at the rate of 97·5 lb. per acre.

Phosphate equivalent to 80 lb. per acre of P_2O_5 derived from 400 lb. per acre of superphosphate.

Variety.—Cash.

Planted.—21st January.

Harvested.—May-June.

Soil.—Reddish-brown loamy sand.

Subsoil.—Red sandy.

A good even growth was obtained on all plots with the exception of one, a large part of which suffered from nematode infestation. The quality of all the leaf was good. No difference of any significance was discernible in the quality of the leaf from the different treatments on examination of the bulks. It was intended to have the leaf graded in detail, and smoking tests made on samples of it, but, unfortunately, owing to a misunderstanding, the leaf from the different treatments became mixed in the grading process. It is interesting to note that the different applications of potash have had no different effects upon the yields from the various plots. This accords with the results of the

previous season's trials. Though no marked difference between the quality of the leaf from the different treatments was observed, it is possible that smoking tests on the leaf would have produced evidence of differences.

It is intended to conduct a series of trials with potash at a later date with the endeavour of determining the quantity required to bring out the best qualities of the leaf.

YIELDS :—Lb. cured leaf from 1/50-acre plot.

2K 21·7	5K 25·3	4K 25·3	1K 21·9	3K 22·1
1K 24·1	4K 24·8	5K 24·4	3K 23·1	2K 21·9
3K 24·4	1K 25·2	2K 24·6	4K 22·1	5K 24·0
4K 25·1	2K 29·1	3K 20·6	5K 17·3	1K 22·9
5K 24·1	3K 27·9	1K 26·7	2K 18·4	4K 26·1

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares	Mean Square.	½ loge (Mean Square).
Rows	4	8·478	..	..
Columns	4	89·906	..	..
Treatments	4	9·758	2·440	..
Errors	12	61·404	5·117	..
Total	24	169·546	..	..

SUMMARY OF YIELDS.

Treatments.	1K	2K	3K	4K	5K
Yield (cured leaf), lb. per acre	1,208	1,157	1,181	1,234	1,151
Cured leaf, percentage mean yield	101·9	97·6	99·6	104·0	97·0

Discussion.

The different applications of potash have had no significant effect upon the yields.

R. R. BROWN, BROUGHTON, CHARTERS TOWERS.

This trial was designed to test the effects both of nitrogen and of phosphate applied in different quantities.

It was laid out as a 5 × 5 latin square. However, it was found impracticable to properly irrigate a number of rows on the outside of the end column, owing to the land not having the necessary fall, and the plants in this section did not develop. The column has been left out, and in the analysis the plot has been treated as a 5 × 4 randomised block, as greater precision in the comparisons is to be gained by so doing. The five treatments were as follows:—

1.—N.P.K.

2.—N. 2P. K.

3.—2N. P. K.

4.—2N. 2P. K.

5.—2N. 3P. K.

where—

N. = 15 lb. of nitrogen per acre; of which half is derived from dried blood at the rate of 60 lb. per acre, and half from nitrate of soda at the rate of 48·8 lb. per acre;

2N. = Double the foregoing quantities;

P. = 40 lb. P_2O_5 per acre; derived from 200 lb. per acre of superphosphate;

2P. = 80 lb. P_2O_5 per acre; derived from 400 lb. per acre of superphosphate;

3P. = 120 lb. P_2O_5 per acre; derived from 600 lb. per acre of superphosphate;

K. = 30 lb. K_2O per acre; derived from 62·5 lb. sulphate of potash.

Variety.—Hickory Pryor.

Planted.—15th and 16th January, 1935.

Harvested.—May-June-July.

Soil.—Grey, fine sandy loam.

This crop was grown with irrigation. High temperatures and the absence of rain for some time after planting were not conducive to rapid growth. Subsequently conditions improved and the resultant growth was good. The leaf is being graded; details of grades are not yet available.

The crop received waterings on the 25th February and on the 29th March.

The rainfall recorded at Charters Towers was as follows:—

Month (1935).	Wet Days.	Points.	Average.
January	8	302	551
February	6	215	445
March	9	135	368
April	..	..	153
May	5	107	79
June	5	115	125
July	5	175	62

YIELDS :—Lb. cured leaf per 1/50-acre plot.

2N2P 20·5	N2P 29·7	NP 27·7	2NP 25·5	
NP 20·5	2N3P 31·2	2NP 28·5	N2P 26·7	
2N3P 28·2	2N2P 30·0	N2P 30·0	NP 29·2	
N2P 24·2	2NP 25·0	2N3P 28·0	2N2P 29·7	
2NP 18·2	NP 24·8	2N2P 27·5	2N3P 31·0	

ANALYSIS OF VARIANCE.

Due to.	Degrees of Freedom.	Sum of Squares.	Mean Square.	$\frac{1}{2}$ loge (Mean Square).
Blocks	3	134·31	..	..
Treatments	4	65·56	16·390	1·3983
Errors	12	56·82	4·735	·7775
Total	19	256·69	..	..

Standard error (4 plots) $= \sqrt{4 \cdot 735 \times 4}$.
$= 4 \cdot 4$
$= 4 \cdot 1\%$ of mean yield.

SUMMARY OF YIELDS.

	1.	2.	3.	4.	5.
Treatments.	NP	N2P	2NP	2N2P	2N3P
Yield (cured leaf), lb. per acre	1,278	1,383	1,215	1,346	1,480
Cured leaf, percentage mean yield	95·3	103·1	90·7	100·5	110·4

Discussion.

There is a steady increase in yield with increasing applications of superphosphate. The increases in yield due to consecutive increases in phosphoric acid are not significant, but the treble dressing of superphosphate (treatment 5) has caused a significant increase in yield over the single dressing (treatment 3).

There is no significant difference between the yields of the single and double dressings of nitrogen.

EXPIRED SUBSCRIPTIONS.

A very large number of subscriptions to the Journal expired in June, and have not been renewed. A further large number expires with this issue.

Subscribers whose term has expired have been continued on our mailing list, and a yellow wrapper on this month's Journal (July) is an indication that their subscriptions are now due.

Address renewals without delay to the Under Secretary, Department of Agriculture and Stock, Brisbane.



FARMERS' WOOL SCHEME.

[*Continued from p.* 584, *June issue.*]

IT is thought that the advantages to be derived by farmers from the use of this scheme are not generally known. There is no doubt that a substantial financial loss is sustained by those farmers who send small parcels of wool for sale through the ordinary channels. Bags, for instance, are not even auctioned but are disposed of by private treaty. In nearly all cases these oddments are purchased by dealers who class and interlot, eventually making a substantial profit which should really be in the pockets of the producer.

The Farmers' Wool Scheme is for the assistance of such producers. No matter how small the lot it receives the same attention as larger lines, and eventually finds its way into a bulk line, thus meeting with the full competition such as is given by buyers to station lines.

To give some idea of the service rendered it should only be necessary to quote the results of a recent sale in Brisbane. The offering was one of 50,000 bales, and the average price received for the whole of the offering was 14·9d. per lb. In this sale the Department offered 107 bales of wool on account of farmers from all over the State. The average price received was 14·8d.

This season the number of farmers directly interested in the scheme is 103, and should be more. To give some idea of how the wool is treated, it is necessary to point out that whereas a station clip would probably be classed into fourteen or fifteen lines the wool handled by the Department's scheme last season classed up into eighty-six lines, including merino, comeback, and crossbred. It may be thought sometimes by an individual farmer that the charge for fresh packs is excessive. It must be borne in mind that in many cases bales are purposely made light so as to achieve a five-bale line, thus avoiding star lots.



PLATE 35.

WOOL CLASSERS AT WORK.—General view of the Departmental Wool Room showing some of the bins of Classed Wool.



PLATE 36.
Filling the Bales for Pressing and Entering Up in the Bale Book.

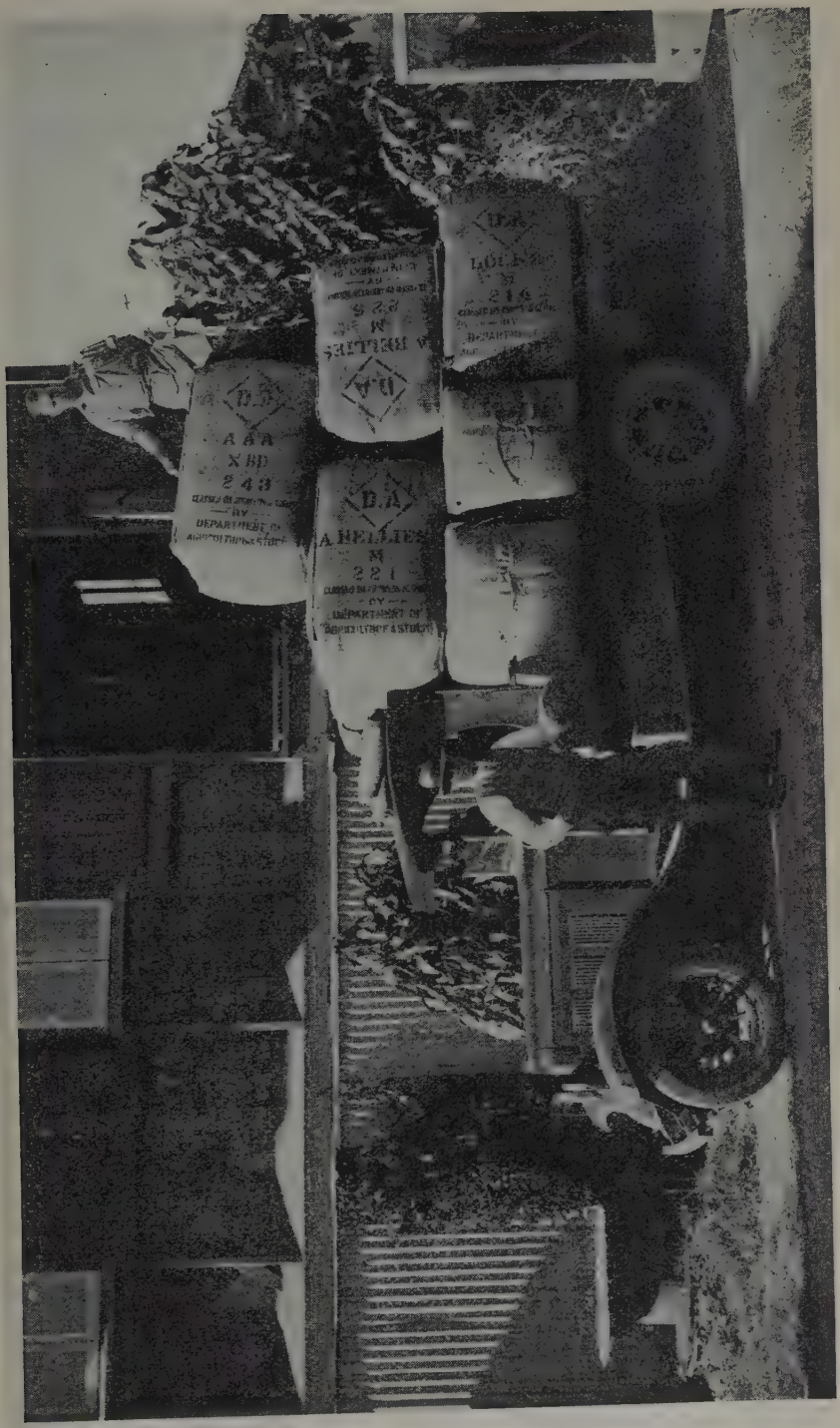


PLATE 37.
A Load of Classed Wool Ready for Dispatch to the Selling Floor.

USE OF LICKS FOR SHEEP.

J. L. HODGE, Instructor in Sheep and Wool.

IT is a fact to be regretted, but nevertheless a fact that a great portion of the grazing areas of Queensland and Australia are deficient in phosphates. This fact being known and admitted, it is obvious that the deficiency should be made good with the well-being of the flocks at stake. The simplest way to supply this deficiency is in the form of a lick to which sheep should have free access during those periods of the year when it is likely to do most good.

The scientific use of the different ingredients in a lick should be determined by the analysis of the pastures and waters to which the flocks have access. The amounts used should be strictly in accordance with the deficiencies found. For instance, if the water is saline the proportion of salt used in a lick would be reduced, and in some cases the supply of salt should be reduced to a minimum. Conversely, where the entire absence of salt is shown the amount in the lick should be increased.

Apart from salt the greatest necessity amongst our flocks is phosphoric acid and lime. This may be supplied in a number of ingredients, such as nauru phosphate, sterilised bone meal and dicalcic phosphate being the principal ones. There is now on the market a preparation put up by the Queensland Meat Board called "Calphos." This is a sterilised bone flour, rich in phosphoric acid and lime and containing some small amount of protein and fats. It is prepared from selected bones only. Now that we are assured that the supply is continuous the preparation is to be highly commended.

Sulphate of iron is advisable in a lick in small proportions. It is tonic in its effect.

Epsom salts are invaluable as an ingredient and as it is comparatively cheap when bought in quantity a great deal more use should be made of it during those seasons when its presence in the lick is likely to do most good. I refer to such periods as hard winter feeding or when the sheep are on scrub.

During these periods, also, we have found the use of a good meal beneficial. Not only does it induce the flocks to take the lick more freely, but a direct benefit is derived from the protein contents.

The following lick is recommended, with the advice that proportions be changed to suit local conditions as the necessity arises:—

Calphos (obtainable from the Queensland Meat Board)	40 parts
Salt (Butcher's quality)	40 parts
Sulphate of iron	2 parts
Epsom salts	6 parts
Linseed meal (or some other good meal)	12 parts

The whole of this mixture may be bound with molasses. Although the feeding value of molasses is not high it is rather remarkable how fond sheep are of it. Its properties are chiefly appetising and laxative.

In the lick above given you have in the Calphos, phosphoric acid and lime an absolute necessity to the health and maturity of the sheep. Salt may be also regarded as a necessity, except in the case above stated where the water is sufficiently saline to dispense with its use. Sulphate or iron is a tonic. Epsom salts is a laxative, and the meal recommended is a protein.

It is necessary that the grazier should know the properties of the various ingredients so that he may be able to intelligently vary the proportions given to suit certain seasonal conditions.

For instance, with salt, as already stated, the greater the proportion of salt in the water the less of this ingredient would be prescribed in the lick.

The proportion of the phosphoric acid bearing ingredients may always be used. Epsom salts would naturally be cut down in a flush season or one in which young herbage has made its appearance.

The meal recommended should only be used when it is economically sound to do so, such as hard winter conditions or when the sheep are on scrub. Some graziers contend that it is economically sound and beneficial to use a lick all the year round, apart from seasonal conditions. I think, however, that most benefit is to be derived where there is a shortage of feed and when sheep are on scrub. It should be the object of the grazier to induce his sheep to take the lick as prescribed in a quantity varying from three to four ounces per head per week.

To save waste it is necessary to provide a special lick trough. The type recommended consists of a V-shaped trough, with an opening at the bottom to allow the lick free access to a lick board, which is bevelled at the edges to prevent the lick falling to the ground. The trough should have a hinged top to protect the mixture from the weather. The use of open troughs is not to be encouraged. Apart from the fact that there is the loss from weather conditions, the sheep themselves foul the mixture to the detriment of those following.

This advice against open troughs especially applies where blood meal is used as an ingredient in the lick. Should this mixture become wet there occurs a chemical reaction which is definitely dangerous to the sheep.

The effect of a good lick on the flocks is undoubted. Apart from the general health of the flocks a lick as prescribed enables the sheep to make better use of pastures to which it is confined. It should always be remembered, too, that the health of a flock has a deal to do with the resistance of the animal to internal parasites. The extra return from a healthy sheep more than pays for the cost of the lick.

Should the grazier prefer to have his lick mixed ready for use, this may easily be arranged with the various business houses dealing in the ingredients. For a small extra charge the very excellent machinery used for the purpose is at the disposal of the grazier.

To conclude, I should strongly advise graziers to give more attention to this important branch of animal husbandry, with benefit to themselves financially and to the flocks of the State.

A Hot-Water System for the Farm.

H. W. KERR.*

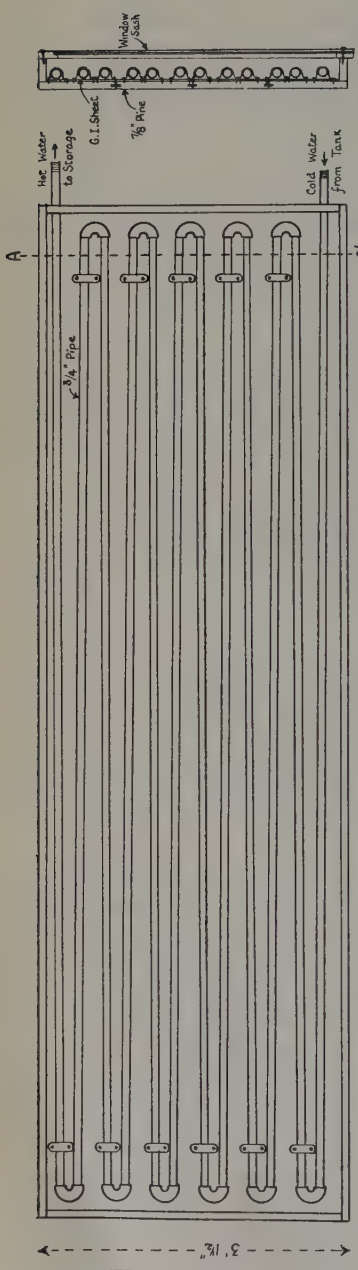


PLATE 38.—Illustrating the construction of the heat-absorption coil and glass-covered box.

THE average household needs much hot water for bathing and cleansing purposes, and this is particularly true on the farm. Yet the absence of conveniences for its provision at short notice generally means that it is not available as desired, and the farmer and his family must get along without it. For those who are prepared to expend a few pounds in the construction of a simple system in which operating costs are practically nil a description of the so-called "Solar Heater" is here supplied. It has been developed in America, and has also been widely adopted around the mills and plantations in Hawaii. It seems to offer a practical means of supplying hot water for the farm.

The system depends for its success on the ability of an exposed metal surface, when protected from the wind by a glass frame, to absorb heat from the sun's rays. If the metal surface takes the form of a continuous coil of iron piping the heat thus absorbed may be transmitted to water circulating in the coil; and if the heated water can be removed to a storage vessel and replaced by cold the process may be continued so long as the sun is shining.

The layout may best be described with reference to the accompanying diagrams (Plates 38 and 39). In Plate 38 is shown the plan of the heating coil, together with a section *AA'* through the box. The latter is 10 feet 6 inches by 3 feet internal dimensions, and is constructed of ¾-inch timber. The sides are 3 inches high. The bottom is lined with a sheet of

*Reprinted by courtesy of Dr. Kerr from the "Cane Growers' Quarterly" (Bureau of Sugar Experiment Stations).

galvanised iron. On this is clamped a coil constructed as shown from ¾-inch piping. The galvanised sheet and the piping should be painted dull black. The lid of the box consists of glazed window sashes, which prevent air currents from cooling off the pipes, yet allow free penetration of light. This box is set on the roof of a building or other suitable location at such an angle as to afford maximum exposure to the rays of the sun. In Queensland it will require a northern exposure, and should be tilted at an angle of 20 to 30° with the horizontal. In the far-northern areas the lower angle should be employed, while 30° would be most suitable in Southern Queensland.

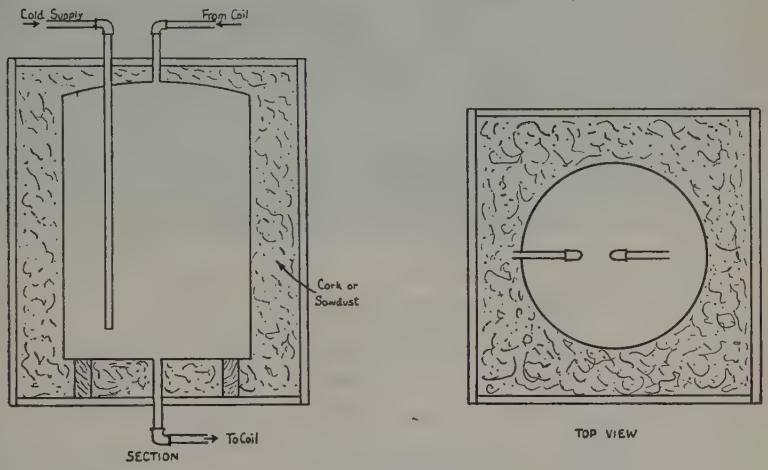


PLATE 39.

Showing the construction of the hot water storage tank and the manner in which it is insulated.

The free ends of the coil pipe are led to the water storage tank (Plate 39), which is placed either between the ceiling and the roof of the building or in a specially constructed chamber on the roof. Care should be taken to provide a tank of ample proportions—one of 50 to 60 gallons capacity is generally suitable. This should be placed in a wooden box which will allow of a thick insulating layer of fine cork, sawdust, or fine, dry bagasse all around. This is a most important factor in the retention of the water at a high temperature. A cold water supply from a high house tank or water main should be brought into the storage cistern, as shown, while the hot water connection for the household supply may be taken off from any convenient point near the top of the cistern. A tee on the pipe from the top of the coil across to the storage tank will prove satisfactory.

For those who wish to alter the dimensions of the installation suggested it may be taken as a useful guide that under normal conditions 1 square foot of surface area should be allowed for each gallon of water to be heated to a temperature of 150° F. It may be of interest to point out, also, that some heat is absorbed by this system even on hazy or cloudy days. Naturally the solar heater would be best suited to those districts which enjoy a high proportion of clear, sunny days, but its usefulness should also be considerable in the high rainfall areas, particularly during the winter season.



SOME TROPICAL FRUITS.

No. 9—THE SUGAR APPLE.

S. E. STEPHENS, Northern Instructor in Fruit Culture.

AMONGST tropical fruits this member of the order Anonaceæ is probably more widely distributed throughout tropical parts of the world than any other except, possibly, the mango. In fact, so early was its distribution and so well did it adapt itself to the various countries to which it was introduced, that its actual native habitat cannot now be proved. It is thought, however, to have originated in tropical America.

Amongst the Anonas it was the earliest introduction into Queensland, and became well established and widely spread throughout the coastal districts in a very short time. In 1911 A. H. Benson, in his publication "Fruits of Queensland," stated it was the species commonly grown. Since that time it has, however, been superseded in Southern Queensland by the Custard Apple (*Anona cherimolia*), which is a better commercial type of fruit and more suited to the sub-tropical conditions of the southern parts of the State.

In North Queensland the Sugar Apple still holds pride of place, and by most Northerners its fruit is considered to be in a class above the Custard Apple so far as delicacy of flavour is concerned.

The specific name applied to this fruit is *Anona squamosa*, which means "scaly anona," and refers to the skin of the fruit being composed of numerous scales or plates separated by deep corrugations or interstices. When the fruit becomes quite ripe the individual scales are easily detached and will fall apart, thus making the ripe fruit difficult to handle.

The tree is a small one, growing to a maximum height of 15 to 20 feet. It is extremely adaptable and grows over a wide range of conditions, but well-drained light soils and rather dry and hot conditions give the best results. In the Cardwell district of North Queensland, where the ideal conditions are most nearly approached, it is to be met

with growing in the black sand along the foreshore and successfully competing with the indigenous vegetation. On both forest and scrub lands in outlying parts of that district it may be seen thriving in gardens cared for or abandoned, but it seems to be more at home in the black sand, where the seeds germinate where they fall and the plants grow in profusion and fruit regularly and heavily. The wetter conditions farther north, between the Tully River and Cairns, are not so favourable, generally speaking, and although the trees will grow and fruit they do not actually thrive in the same way.

The tree is a deciduous one, but its fruiting habit is different to that of most other deciduous trees in that it fruits on the current season's growth as well as on the older wood. The flowers are produced singly and in clusters and are greenish-yellow in colour with thick outer petals about an inch in length. September to November is the usual flowering period here. Only a small proportion of the flowers set, but even so the trees are usually well laden with fruit. The crop commences to ripen during late January and usually continues to late April, but in some seasons odd fruit may be picked from the trees up to June. When fully grown the fruit is from 2 to 4 inches in diameter, deeply corrugated, with a dull, pale-green skin changing to yellowish-green as the fruit ripens. Maturity is gauged by the opening and lightening in colour of the interstices between the scales. When this occurs the fruit should be picked and stored for two or three days, when it will be fit for consumption.

The flesh is white, custard-like, sweet, and melting. Carpellary divisions are pronounced and each one normally contains a seed, consequently the seed in a fruit are usually numerous. However, it has been noted that some trees consistently bear fruit with less seed than others. Such points as flavour and productivity also vary in different trees, hence it follows that strict selection of propagating material is desirable if improvement in the general quality of the fruit is to be attained.

Both to maintain vigour of the tree and quality of the fruit regular pruning is recommended. In the early stages of growth this should be directed to forming the tree and will consist chiefly in heading back of the main arms to produce shape and rigidity and develop lateral growth. Once having obtained the framework subsequent pruning is mainly directed towards thinning out and shortening back to prevent overcrowding and to maintain healthy growth. As the tree is naturally more compact and upright in growth than the Custard Apple, pruning need not be so severe as is required to train that tree. The Sugar Apple is naturally precocious and will commence to fruit at three to four years of age.

In the pruning of Anonas there is an important point to be borne in mind. It is that pruning should not be commenced on a tree of this family until the sap is beginning to rise in the spring and movement is noticeable in the buds. Neglect to observe this rule will frequently result in the death of the tree.

The chief pest noted on Sugar Apples is the mealy bug. Its occurrence is mainly restricted to the fruits, the surfaces of which are sometimes completely covered with the insects. The usual spray of nicotine sulphate and soap applied with force will cope with this pest satisfactorily.

The green tree ant frequently establishes colonies in the trees, but these are easily destroyed with paris green. A method of application with which the writer has had excellent results is to make a strong mixture of paris green with water—about 1 lb. to the gallon. Dip small pieces of rag about 3 inches by 2 inches into the mixture, then push one piece into each nest with the aid of a stick. In about a fortnight's time the nest will disintegrate and the dead colony will be seen within it.

In addition to the name Sugar Apple, this fruit is known as Anona and Sweet Sop in various parts of the world. In North Queensland it is frequently but quite erroneously called Custard Apple, this name having been reserved to its cogener, *A. cherimolia.*

PACKING LETTUCE FOR MARKET.

JAS. H. GREGORY, Instructor in Fruit Packing.

IN a warm climate such as that of Queensland the populace in summer makes extensive used of salad foods, such as is provided by lettuce, to make their meals tempting and appetising. To walk through the markets and see the bags and heaps of lettuce displayed does not, however, encourage the thought that they are being given to the public in the best possible manner. A little care taken in packing would greatly improve their appearance and value to the public, and with this object in view it is suggested that more up-to-date methods of packing should be adopted. The tropical fruit case, as used for bananas and pineapples, is ideally suited for the purpose.

Harvesting.

The heads of lettuce should be carefully cut and not pulled as is often done. The cutting should be done as far as possible during the early morning before the sun and heat have had time to make the lettuces lose their crispness. The heads should be placed in heaps conveniently in the rows, or, if in large quantities, carted to a central shed to be packed.

Packing.

The lettuces should be sized for packing into sets of reasonably even size. They can be placed either in heaps ready for packing or, if more convenient, straight into the cases. When finished each case should contain a number of fairly evenly sized specimens.

The placing of the heads in the case is most important. The hearts fig. 1. Smaller sizes can be packed diagonally by placing them two and one alternately. (Fig. 6.) The second layer is packed by placing of the case. Large lettuces are placed side by side as illustrated in are placed downwards, the cut stalks pointing straight up to the top them upon the spaces of the first, in the same manner.



Fig. 1.
First layer, two across, 16 pack = two layers of eight.

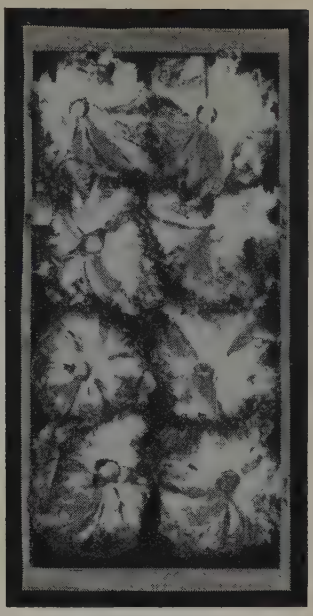


Fig. 2.
Finished case, 16 pack.

In this pack the lettuces are pressed tightly together. This makes each row higher, so that two rows will bring them to the top.



Fig. 3.
First layer, two across, 18 pack = three layers of six.



Fig. 4.
Finished case, 18 pack.

PLATE 40.

In this pack the lettuces are placed in the case in firm but not in tight rows, a little to one end of the case. The second layer is placed on the spaces between each of the twos, allowing each row to fit down, thus requiring three rows to bring them to the top of the case.

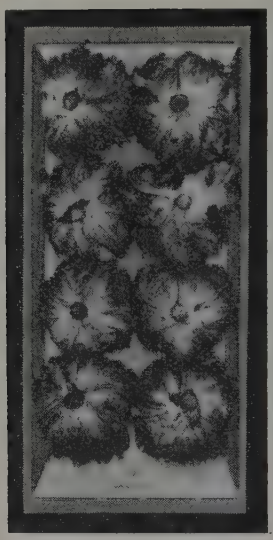


Fig. 5.

First layer, two across, 24 pack = three layers of eight.



Fig. 6.

First layer, two and one, 27 pack = three layers of nine.

Pack firmly.

The lettuces are placed in firmly and three layers packed to fill the case.



Fig. 7.

First layer, two and one, 32 pack = three layers (bottom layer 11, second layer 10, top layer 11).

Pack firmly.



Fig. 8.

First layer, two and one, 36 pack = three layers of twelve.

Pack tightly.

PLATE 41.

The following is a table of counts that can be used:—

Type of Pack.	Number in each layer.	Number of layers.	Total heads in case.
Two across	8	2	16
Two across	6	3	18
Two across	8	3	24
Two and one alternately	9	3	27
Two and one alternately (See Fig. 7)	11, 10, 11	3	32
Two and one alternately	12	3	36

Smaller lettuce can be packed on the same system using different counts and being placed 3 across.

As no lids are placed upon the boxes when sending to local market, the rows of lettuce can be brought above the top of the case to the extent of about half a layer without running any risk of damage to the contents if the boxes are handled carefully.

CITRUS NOTES.

R. L. PREST, Instructor in Fruit Culture.

IN the warmer districts, where the harvesting of navels and early varieties of citrus has been completed, pruning may now be commenced.

With citrus, the pruning requirements of each tree are dictated by various factors, including the tree itself, the soil, and cultural conditions.

In the younger orchards, where well developed frameworks have been maintained, the pruning of the trees during their first years of bearing should be directed towards the removal of suckers and decadent first-fruiting shoots. Where pruning operations have been diligently carried out on young trees, they require very little pruning during several following years, although they should be gone through annually to remove suckers and dead wood.

In many of our older but well-cared-for orchards there is a lack of vigorous healthy fruiting wood. This condition points to the necessity for a periodical renewal of the fruiting wood, which can best be accomplished by thinning out, and at the same time shortening back terminal growths and twigs. The cuts should be made right back to strong new growths, removing weak shoots and those that have borne fruit. The thinning leaves space for the necessary subdivision, whilst the shortening back tends to force into growth dormant buds from behind, and at the same time stops the excessive growth of branches and renews supplies of fruiting wood. Where crowding is evident, the removal of entire branches is at times desirable. The entry of plenty of light and air assists the growth from behind the outside ring of foliage of healthy and vigorous shoots which make new fruiting wood. Any excessive growth of suckers or water sprouts arising well inside the tree as a result of heavy pruning require to be cut away, or they will absorb much of the vigour of the tree and crowd the centre.

In older trees, where vitality has been impaired, provision will require to be made for the renewal of old, crowded, and decadent limbs. In such instances pruning is of a much heavier nature, necessitating the removal of entire branches. Such branches should be cut right back to their source of origin, so that the sap will be readily diverted to the remaining limbs and encourage the formation of new fruiting wood. Under no circumstances whatever should stubbing be resorted to. In instances where it is necessary to replace the larger limbs, the work requires to be done gradually over two or more years in order to avoid excessive suckering.

Lower branches of trees should not be allowed to touch the ground, as fruit borne on such branches is generally blemished and of poor quality. On the other hand, trees should not be pruned too high from the ground. The height to which they should be lifted varies according to circumstances, but in most instances knee-height will prove to be satisfactory.

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit Packing.

NOTWITHSTANDING the cold weather during the latter part of June, the general market prospects remained bright and prices for good fruit steady. From July onwards it will be necessary to watch closely apples and pears in cold storage. The writer examined some lines of Stanthorpe apples—Dunns, Granny Smith, and Delicious—in cold storage recently, and found them in a satisfactory condition. Large sizes should now be placed on the market in small, regular lots. It should be remembered that regularity of marketing is the only way to get the best a market can give.

In previous notes it has been pointed out that in quieter periods of the year it is desirable to put the packing house in order and make handy home-made equipment in readiness for next season.

Apples.

Stanthorpe Granny Smiths brought from 8s. to 12s. per case, and Southern Jonathans ($2\frac{1}{2}$ to $2\frac{3}{4}$-inch) from 11s. to 12s. Queensland growers with Jonathans in cold storage should now consider placing them on the market.

Pears.

Southern Packhams realised from 8s. to 11s., Josephines from 8s. to 13s., and Winter Coles from 7s. to 14s.

Many Southern consignments are now marketed with the brand printed nicely on the ends of the boxes in colours instead of a pasted fancy label. This method appears to be quite satisfactory.

Bananas.

Cavendish have maintained the rise in prices, choice lines selling as follows:—

Brisbane.—Sixes, from 6s. 3d. to 10s. 6d.; sevens, from 7s. 9d. to 12s. 3d.; eights and nines from 7s. to 14s. per case; bunches, from 3d. to 7d. per dozen.

Melbourne.—Sixes, from 13s. to 14s.; sevens, from 15s. to 16s.; eighth and nines, from 17s. to 18s. per case.

Sydney.—Sixes, from 12s. to 14s.; sevens, from 15s. to 16s.; eights and nines, from 17s. to 20s. per case.

Lady's Fingers were in good demand, up to 7d. per dozen being obtained for good fruit.

Provided fruit affected by the cold weather is not marketed prices should be maintained on this basis for some months to come.

Pineapples.

Brisbane prices of Ripleys will possibly show a tendency to ease during the cold weather, buyers being afraid of black heart. Prices are from 3s. to 5s. per case, and 1s. to 3s. per dozen.

Smooths realised from 4s. to 9s. per case in Brisbane, with a few specials at 10s.; loose sold at from 2s. to 6s. per dozen.

In Sydney the demand has been slow for the larger sizes, prices ranging from 7s. to 13s. In Melbourne Smooths brought from 9s. to 14s. per case.

Care should be taken not to send green fruit. When prices are low fifteens, eighteens, and twenty-ones are the most popular sizes, while when high prices prevail the buyers favour eighteens, twenty-ones, and twenty-fours.

Custard Apples.

This fruit is inclined to be slow of sale, 2s. to 3s. per half-bushel case being obtained. Mature fruit only should be marketed.

Melbourne prices range from 5s. to 7s. Care in marketing only matured fruit should also be applied to consignments to Victoria.

There is a fair demand in Sydney, with prices from 4s. to 5s. per case.

Papaws.

Brisbane prices range from 2s. to 4s. 6d. per bushel case for locals, 5s. 6d. to 6s. 6d. per tropical case for Gunalda, and 7s. to 9s. for Yarwun. During the winter months fruit should be left hang on the trees for a longer period in order to permit colouring.

Sydney prices are from 8s. to 12s. per tropical case, and Melbourne prices from 10s. to 14s. To maintain these prices only good fruit must be sent. Green fruit will soon reduce values.

Other Tropical Fruits.

It seems a pity that fruits such as the Granadilla, Sour Sop, Five Corners, and others are not placed on the Brisbane market in larger and more regular quantities.

Oranges.

Common oranges are slow of sale at from 3s. to 6s. Navels are in better demand at from 6s. to 8s. for locals, with Gayndah fruit bringing from 7s. to 10s. per case, and Benyenda from 8s. to 10s. Southern Navels of good packs sold at from 7s. to 8s. per case.

In Sydney Benyenda Navels brought from 8s. to 10s., and locals from 3s. 6d. to 8s.

Mandarins.

Some splendid fruit has been marketed. Some districts suffered from mould early in June as a result of the wet weather.

Brisbane prices for local Emperors ranged from 3s. to 6s. per bushel, for Gayndah Glens from 6s. to 11s., with Benyenda to 12s. and others to 7s. per case. Small-sized fruit are hard of sale. Scarlets brought from 3s. to 6s., and Fewtrells from 3s. to 8s.

Sydney prices for Benyenda Glens were from 10s. to 13s., and for other Queensland fruit 10s. to 12s. In Melbourne Emperors and Scarlets brought from 8s. to 10s., and Benyenda Glens from 12s. to 14s. per case.

Lemons.

Prices for locals are from 4s. 6d. to 7s. per case, with Gayndah realising 9s. to 12s. It is becoming more apparent day by day that only cured lemons can command top market prices.

Grapefruit.

There is still a good demand for good quality fruit, up to 9s. per case being obtained. In Melbourne there is good demand for choice Marsh type, which are realising up to 12s. per case.

Passion Fruit.

First quality fruit is in good demand in Brisbane, realising up to 10s. per case.

Tomatoes.

In Brisbane green fruit realised from 1s. 6d. to 3s. 6d., and firm coloured lines from 2s. to 5s. per case. In Sydney Bowen fruit realised from 6s. to 8s., and Cleveland fruit from 4s. to 6s.; local New South Wales fruit brought from 6s. to 10s. No green tomatoes are wanted on the Sydney market. In Melbourne green tomatoes brought from 4s. to 6s., with ripe fruit higher.

An inspection of the fruit arriving on the Cairns and Townsville markets supports the contention that tomatoes for those markets should be wrapped.

Wrapped lines opened up 200 per cent. better in quality and appearance.

Strawberries.

A better demand exists for good quality lines, 5s. to 9s. being realised for average quality, and 10s. to 14s. for choice fruit. On the Sydney market trays brought 2s. 6d. to 4s., and boxes from 9s. to 15s. per dozen.

Attention is called to the necessity for branding the grower's name and address on the boxes when marketing. This, coupled with a neat pack, is very helpful to the salesman, and saves many extra handlings, with consequent increased risk of damage.

Publications.

"Apple Packing for Home and Export" will be available for distribution in July.

A lemon packing chart is in course of preparation.

PAPAIN.

H. J. FREEMAN, Senior Instructor in Fruit Culture.

OF late several inquiries have been received requesting information on the method of obtaining papain from that well-known fruit, the papaw.

All varieties of papaws carry this enzyme, but perhaps the thicker-skinned type would yield slightly the greater quantity. The following extract from "Tropical Planting and Gardening," by H. F. MacMillan, a noted writer on tropical fruits, describes the method of preparation of this product:—

"Papain, a digestive enzyme valued in medicine and in the preparation of chewing gums, &c., is obtained from the white, thin latex or juice. The latter is extracted by making slight incisions with a bone knife or wooden splinter in the unripe fruit; the juice rapidly exudes from the cuts, and is collected in a cup held beneath. It is then spread on glass to dry in the sun or, if the weather be wet, over a stove or in a hot-air chamber. Drying should be effected without delay, but should not be too rapid, a temperature of about 100 deg. Fahr. being recommended. The process should be completed in about twenty-four hours. When the material is crisp-dry it is reduced to a fine powder or made into a granular form like vermicelli. It is then of a greyish colour, and has an unpleasant odour. It should be packed in hermetically-sealed tins or bottles for export. About 5 to 8 oz. of dried papain may be obtained per tree in a year, or an average of about 150 lb. per acre. The fruits may be tapped at intervals of two or three days, and are not removed from the tree until they cease to yield latex. Fair to good quality papain formerly fetched from 6s. to 10s. per lb., but the demand is limited and irregular. Papain, as already stated, is used in medicine, in invalids' and children's foods, in chewing gums, &c. The property of papaw leaves in rendering meat tender is well known, and is commonly made use of by native cooks, who wrap the leaves round fresh meat or place a piece of green fruit in the water in which the meat is boiled. One hundred and twenty-eight thousand four hundred and sixty-three pounds of papian, valued at £44,956 were exported from Ceylon in 1929."

TREES.

I think that I shall never see
A poem lovely as a tree.
A tree whose hungry mouth is pressed
Against the earth's sweet-flowing breast;
A tree that looks at God all day,
And lifts her leafy arms to pray;
A tree that may in summer wear
A nest of robins in her hair;
Upon whose bosom snow has lain;
Who intimately lives with rain.
Poems are made by fools like me,
But only God can make a tree.

—JOYCE KILMER.



THE month of June was ushered in with some good general rains which were of particular benefit to the Central and North-Western districts. The North and Central Coast also registered good falls, but the South Coast and Downs lands received only scattered showers.

Unsettled weather prevailed until 12th June, when the Darling Downs participated in the general rain, receiving from ½ to 1 inch. The season has been very unsatisfactory for the successful establishment of winter fodder crops and grasses which need to be sown during early autumn for the provision of winter feed. Some well-worked fallow lands, sown early, have benefited by the June rains, but the area of such is not extensive.

Wheat.

Sufficient rain was received to germinate areas sown dry, but further falls are necessary in the near future, particularly in the Warwick district, where subsoil moisture is negligible. Drilling has proceeded rapidly wherever possible, and although somewhat late in the season, the general sowing is ahead of the previous year, when planting rains were delayed until 30th June. Prospects are bright in the Dalby district, where seasonal conditions have been more favourable, and some large individual areas of both wheat and canary grass are in evidence. Indications point to a large proportion of the crop being derived from the Dalby and Pittsworth areas. The recent payment of 6d. per bushel on the 1935-36 crop brings the amount distributed to 3s. 6d. per bushel for Q1 wheat, which can be regarded as satisfactory.

Organisation of the Potato Industry.

A Federal Potato Advisory Committee has been formed, the first meeting of which was held in Sydney on 17th March last. Two Queensland delegates attended the meeting, at which a resolution was carried stressing the unsatisfactory position of the industry throughout Australia, and suggesting uniform State marketing and grading legislation. The chief objects of the Federal Potato Advisory Council are to advise on all matters affecting the welfare of the potato industry, to prepare and distribute propaganda on the need for orderly marketing, to distribute information and statistics relating to crops and markets, and to secure the co-operation of all States in the regulation of market

supplies. The regulation of supplies to the principal markets is particularly desirable, as at present farmers derive little benefit from a prolific harvest.

Victoria and Tasmania are the most important producing States and normally supply the deficiency throughout the Commonwealth. In Queensland the Lockyer Valley and Boonah districts are the chief sources of supply, with adjacent coastal areas and the Darling Downs also producing good tonnages. Elsewhere production is mainly for household and local supplies, although the area under crop is now increasing throughout the coastal farm lands. However, production has been considerably below average during the 1935-36 season, chiefly owing to unfavourable weather conditions and the increased activity of the potato tuber moth.

Peanuts.

The Peanut Pool Board reports increasing sales of the Virginia Bunch variety, so that farmers will be well advised to sow this type in preference to the Red Spanish during the forthcoming season. Sales for 1935 exceeded the previous record selling year by 25 per cent. The industry is now thoroughly established, Kingaroy peanuts being the hallmark of quality in the Southern markets.

Need for Early Cultivation.

Land intended for summer crops should now be receiving attention, as thorough winter ploughing, combined with subsequent cultivation, is invariably reflected in increased yields. This is particularly noticeable with the maize crop, deep early ploughing and winter fallow being far superior to the more general practice of allowing the land to be under old maize stalks prior to the spring ploughing.

Sugar.

Weather conditions throughout the cane areas were remarkably mild during the first half of the month, and beneficial rains were received in all areas. These were followed by cooler conditions, which have checked growth, and should assure a rapid increase in sugar content of the crop. To date no frost damage has been reported.

Those North Queensland mills which have already commenced crushing report a low sugar content for the crop due, doubtless to the continuance of favourable growing conditions; but the recent cool change should effect a rapid improvement.

Tobacco.

In spite of varied seasonal conditions Queensland's tobacco crop is on an average of better quality than has hitherto been produced, and the quantity of immature leaf now being marketed is limited. It is estimated that from 3,900 acres planted the yield will be in the vicinity of 2,000,000 lb.

Auction sales to date have been very successful, and at the June sales the values received for better class leaf are at least 5 per cent. above values ruling the previous season. No doubt exists that the increased demand for local leaf has been brought about by the higher tariff now operating on imported leaf, thus causing more buyers to operate and, incidentally, creating keener competition.

Cotton.

The harvesting of the cotton crop has continued through the month under fairly favourable conditions except two short periods of showery weather. The average grade has therefore held up well. Killing frosts occurred around mid-month, which will increase deliveries in the near future, as the top crop will now open rapidly.

The ginnings to the 24th June are as follows:—Glenmore 7,018 bales, Whinstanes 3,081 bales, total 10,099 bales.

Tung Oil Production.

A recent publication from the Imperial Bureau of Soil Science, England, reviews the present position with respect to tung oil production, and suggests that the future of the industry is distinctly promising. The oil has become an indispensable raw material of the paint and varnish trade throughout the world, while the aviation and electrical engineering trades have all tended to promote a marked interest in establishing the tung oil tree in countries other than China, which for years held the monopoly of the tung oil trade.

The oil possesses properties similar to those of linseed oil; it is considered, also, that the oil will always command a price at least £10 per ton above that of linseed oil. An acre of suitable land is stated to be capable of producing up to 1,200 lb. of tung oil. The tree has been established successfully on a commercial basis in Florida and neighbouring States, and in 1934 29,000 acres had been planted to the crop. Test plantings have also been made in India, South Africa, Australia, and other parts of the British Empire.

Many reports from these centres stress the significance of careful nursery management, and lack of attention to this would appear to be the cause of many avoidable failures. Two species of tree are cultivated—*Aleurites montana,* which appears to withstand heavier rainfall and requires higher temperatures than *Aleurites fordii,* from which the true tung oil is derived. The latter is generally regarded as yielding the superior oil, and this species is generally favoured wherever the crop is propagated successfully.

The search for alternative and profitable crops to supplement cane-growing, which is constantly engaging the attention of Queensland cane-growers, suggests that the tung tree is worthy of closer attention. The fact that no definite provision has been made for the construction of factories to treat the mature nuts should not be lost sight of, though this difficulty could probably be overcome by the installation of the necessary auxiliary plant at the sugar mills.

H.W.K. in the "Cane Growers' Quarterly."

Sugar Levies.

(Abbreviated Notice.)

1936 SEASON.

Regulations under "*The Primary Producers' Organisation and Marketing Acts*, 1926 *to* 1935," have been approved, providing for levies on suppliers of cane to sugar-mills at the following rates for the season 1936 (the figures for 1934 and 1935 are given for comparison purposes) :—

Name of Mill.	General Levy by Queensland Canegrowers' Council.	Administrative Levy by District Executive.	Administrative Levy by Mill Suppliers' Committee.	Special Levy by Mill Suppliers' Committee.	Total Levies for 1936.	Total Levies for 1935, given for comparison.	Total Levies for 1934, given for comparison.
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
Mossman Central	¾	2	..	..	2¾	2¾	2¾
Hambledon	¾	⅜	½	..	1⅜	1⅜	1⅜
Babinda Central	¾	⅜	⅛	..	1¼	1⅜	1⅜
Mulgrave Central	¾	⅜	..	..	1⅛	1⅛	1⅛
South Johnstone Central	¾	1½	⅛	..	2⅜	2¼	2¼
Goondi	¾	1½	⅛	..	2⅜	2¼	2¼
Mourilyan	¾	1½	..	..	2¼	2¼	2½
Tully River Central	¾	1¾	..	..	2½	2½	2½
Macknade	¾	1½	½	..	2⅜	1⅝	1⅜
Victoria	¾	½	½	..	1¾	1⅝	1⅜
Kalamia	¾	..	¾	¾	2¼	1¼	1¼
Pioneer	¾	..	1	..	1¾	1¾	1¾
Inkerman	¾	..	¼	..	1	1	1¼
Invicta	¾	..	1	..	1¾	1¾	2¼
Proserpine Central	¾	1	..	..	1¾	1¾	1¾
Cattle Creek Central	¾	½	¼	..	1½	1½	1¾
Plane Creek Central	¾	½	½	..	1¾	1¾	1¾
Marian Central	¾	½	¼	½	2	2¼	2½
North Eton Central	¾	½	½	..	1¾	1¾	1¾
Pleystowe	¾	½	½	½	2¼	2	2¼
Racecourse Central	¾	½	½	..	1¾	2¼	1¾
Farleigh	¾	½	½	..	1¾	1¾	1¾
Qunaba	¾	¼	½	..	1½	1½	1½
Bingera	¾	¼	½	..	1½	1¼	1¾
Fairymead	¾	¼	¾	..	1¾	1½	1½
Gin Gin Central	¾	¼	½	..	1½	1¾	2
Millaquin	¾	¼	¼	..	1¼	1½	1½
Isis Central	¾	¼	..	..	1	1½	1½
Maryborough	¾	½	..	..	1¼	1½	1¾
Mount Bauple Central	¾	½	..	..	1¼	1½	1¾
Moreton Central	¾	..	1	½	2¼	2½	2½
Rocky Point	¾	..	¾	..	1½	1¾	1¾
Eagleby	¾	..	..	..	¾	1	1

No poll will be taken in respect of the General Levy of ¾d. per ton (first column) for the Queensland Cane Growers' Council, or for the administrative levies by District Executives or Mill Suppliers' Committees (second and third columns).

In the fourth column, the levies on cane supplied to the Kalamia, Marian Central, Pleystowe, and Moreton Central Mills will be used in defraying the costs of employing farmers' representatives at those mills for the current season. In the case of these levies, growers may petition for a poll, and the petition must be signed by at least 100 or 50 per cent. (which ever shall be the less) of the cane suppliers to the four mills concerned.

In addition to the foregoing levies, the undermentioned Mill Suppliers' Committees are empowered to make particular levies on growers within each of the following districts, at the following rates :—

Name of Mill Suppliers' Committee and Mill to which Cane is Supplied.	Description of District upon the Growers wherein Levies will be made and description of Cane upon the Growers whereof Levies will be made.	Amount of Levy per ton of Cane Supplied.	Purposes of Levy.
		d.	
Isis Central ..	Pialba district within the boundaries of the parishes of Urangan, Vernon, and Bingham, county March	1¼	To be used for administrative purposes by Pialba Branch of Isis Central Mill Suppliers' Committee.
Isis Central ..	All cane consigned on the railway by Government trucks from Booyal, Junien, and Marule Sidings on the Dallarnil Railway.	¼	To be used for administrative purposes by Booyal Branch of Isis Central Mill Suppliers' Committee.
Isis Central ..	All cane loaded at Walligan Siding	½	To defray the costs of maintaining the cane growers' derrick at Walligan Siding by the section of growers concerned.
Mount Bauple Central	Mount Bauple district within the boundaries of the parishes of Gundiah, Tiaro, Gootchie, Curra, and St. Mary	¼	To be used for administrative purposes by Mount Bauple Branch of Mount Bauple Mill Suppliers' Committee.
Mount Bauple Central	Yerra district within the boundaries of the parishes of Gungaloon, Denison, Doongul, Woocoo, and Young	¼	To be used for administrative purposes by Yerra-Mungar district Branch of Mount Bauple Mill Suppliers' Committee.
Maryborough ..	Pialba district within the boundaries of the parishes of Vernon, Urangan, and Bingham, county March.	½	To be used for administrative purposes by Pialba District Branch of Maryborough Mill Suppliers' Committee.
Maryborough ..	Maryborough district within the boundaries of the parishes of Tinana, Maryborough, Bidwell, Elliott, Young, and Walliebum, county March.	¼	To be used for administrative purposes by Maryborough District Branch of Maryborough Mill Suppliers' Committee.
Millaquin ..	All cane delivered at Yandaran Siding	½	To be used for administrative purposes by Yandaran Branch of Millaquin Mill Suppliers' Committee.
Racecourse Central	All cane hauled over Silent Grove tramline	½	To be used for local defence purposes by Silent Grove Branch of the Racecourse Mill Suppliers' Committee.
Racecourse Central	All cane hauled over Silent Grove tramline	3	To defray the costs of employing a farmers' representative of the section of growers concerned at the Racecourse Mill for the current season.
Marian Central ..	All cane loaded at Dow's Creek and Langdon Siding	¾	To be used for insurance and weighbridge maintenance by the Dow's Creek and Langdon Branch of the Marian Central Mill Suppliers' Committee.

Growers are given the opportunity of petitioning for a poll to decide whether or not the above levies shall be made. The petition must be signed by at least 100 or 50 per cent. (whichever shall be the less) of the cane suppliers within any of the areas concerned.

All petitions must reach the under Secretary, Department of Agriculture and Stock, Brisbane, not later than 10th July, 1936.

Full particulars of these Regulations appear in the *Government Gazette* of the 10th June, 1936, or may be obtained on application to the managers of the various sugar-mills in Queensland or to the undersigned—

E. GRAHAM, Under Secretary,
Department of Agriculture and Stock,
Brisbane.



PLATE 42.

HON. F. J. S. WISE, M.L.A., MINISTER FOR AGRICULTURE, WESTERN AUSTRALIA.

Mr. Wise, who is a Queenslander and a former officer of the Department of Agriculture and Stock, visited Queensland recently on a tour of investigation of methods of dealing with problems of rural industry common to several States of the Commonwealth. While here he visited The Queensland Agricultural College, at which he was formerly a student and dux in his final year.

The Cairns Hinterland was included in Mr. Wise's tour and a particular note was taken of the methods of handling and receiving maize in bulk at the silos at Atherton and Tolga. Inquiry into the Queensland tobacco industry was also one of the objects of the Ministerial tour.

Mr. Wise was accompanied by Messrs. G. L. Sutton, Director of Agriculture in Western Australia, and Malcolm J. L. Uren of Western Australian Press, both of whom expressed themselves as tremendously impressed with "the almost unbelievable fertility of North Queensland."

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advance Register of the Herd Books of the Jersey Cattle Society, the Australian Illawarra Shorthorn Society, the Ayrshire Cattle Society, the Guernsey Cattle Society, and the Friesian Cattle Society, production charts for which were compiled during the months of April and May, 1936 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
JERSEY.				
MATURE COW (OVER 5 YEARS), STANDARD, 350 LB.				
Brooklands Choice Lady	W. S. Conochie, Sherwood	10,177·16	608·956	Duster 27 Brooklands
Lynahurst Molly	J. B. Keys, Gowrie Little Plains	11,606·17	549·203	Mercedes Noble King of Ogilvie
Westbrook Tulip 10th	Farm Home for Boys, Westbrook	11,199·31	553·247	Westbrook Councillor II.
Trecarne Rosella	T. A. Petherick, Lockyer	9,111·84	513·776	Trinity Officer
Trecarne Rosella 4th	T. A. Petherick, Lockyer	9,857·77	510·646	Trinity Officer
Fauvic Rejoice	H. Cochrane, Kin Kin	7,596·2	471·503	Yingara King
Kenmore Mouse	Wallace Bishop, Kenmore	8,288·53	458·078	Oaklands King Bee
Trinity Mariette	J. Sinnamon and Sons, Moggill	7,802·83	449·544	Trinity Jupiter
Greenstock Buttercup	J. B. Keys, Gowrie Little Plains	7,499·23	444·091	Carnation Larks Baron
Newhills Moya's Pride	J. Nicol Robinson, Maleny	6,218·65	417·364	Prudent of Brooklodge
Nobly Born Irondele	J. Sinnamon and Sons, Moggill	8,180·73	394·905	Nobly Born
Peg of Rosedale (266 days)	J. Schull, Oakey	6,876·42	375·989	Sovereign of Rosedale
JUNIOR, 4 YEARS (UNDER 4½ YEARS), STANDARD, 310 LB.				
Glenview Starlight	F. P. Fowler and Son, Coalstoun Lakes	7,350·07	371·71	Trinity Officer
Trecarne Rosella 6th	T. A. Petherick, Lockyer	6,633·9	360·364	Trecarne Greden King
SENIOR, 3 YEARS (OVER 3½ YEARS), STANDARD, 290 LB.				
Overlook Remus Fawn	E. Burton and Sons, Wanora	8,042·9	444·889	Overlook Favourite Remus

JUNIOR, 3 YEARS (UNDER 3½ YEARS), STANDARD, 270 LB.				
Brooklands Royal Cake	W. S. Conochie, Sherwood	6,541·55	394·991	Retford Earl Victor
Newhills Sybil	J. Nicol Robinson, Maleny	5,570·6	322·672	President of Brook Lodge
Carnation Victorious	W. Spresser and Son, Redbank	5,091·1	312·314	Vinchelez Gordon Victory
Carnation Fairy Lass	W. Spresser and Son, Redbank	5,157·38	308·348	Vinchelez Gordon Victory
SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD, 250 LB.				
Brooklodge Auburn	W. C. Dun, Wolvi	4,881·35	285·765	Brooklodge Minstrel
Brooklodge Ailsa	J. Cummings, Nerang	5,000·52	274·297	Brooklodge Mischief
Lermont Gordon Girl	J. Schull, Oakey	5,484·62	266·858	Trecarne Fern Lad
Kenilworth Una	H. T. Rowe, Kenilworth	4,895·85	265·031	Kenilworth Prince
Woodbine Model (198 days)	J. Williams, Wondai	5,022·95	259·397	Trinity Armlet
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD, 230 LB.				
Oxford Frances	E. Burton and Sons, Wanona	6,220·11	359·625	Oxford Golden Lad
Oxford Fawn	E. Burton and Sons, Wanora	5,691·54	346·84	Oxford Golden Lad
Pet of Calton	A. Gerity, Goomeri	4,987·87	341·065	Adrian of Calton
Newhills Syria 2nd	J. Nicol Robinson, Maleny	4,928·6	339·695	Prince Harry of Newhills
Pineview Royal Star	J. Humber and Sons, Borallon	5,355·04	321·432	Oxford Jeweller
Woodbine Daphne	J. Williams, Wondai	5,418·95	316·251	Armlets Corporal of Woodbine
Ascalon Tibby	C. W. Barton, Wyrelina	6,330·22	299·874	College Renovator
Lermont Rose	J. Schull, Oakey	5,345·42	293·577	Trecarne Fern Lad
Wyrune Peggy	J. R. Keys, Gowrie Little Plains	5,134·37	291·533	Lynahurst Majesty
Trinity Hopeful Blonde	J. Sinnamon and Sons, Moggill	5,445·86	288·556	Some Hope
Carnation Fairy Lass 2nd	Spresser and Son, Redbank	4,495·62	279·544	Vinchelez Gordon Victory
Trecarne Chimes 2nd	T. A. Petherick, Lockyer	5,158·53	276·533	Trelarne Golden King
Trinity Handsome Lady	J. Sinnamon and Sons, Moggill	5,006·31	274·065	Some Hope
Brooklands Royal Roseleaf	W. S. Conochie, Sherwood	5,618·93	271·076	Retford Earl Victor
Bellgarth Viola (257 days)	D. R Hutton, Cunningham	4,679·4	266·686	Airlie Thorn
Glenview Valda	R. P. Fowler and Son, Coalstoun Lakes	4,912·83	260·724	Carlyle Larkspur Empire

Production Recording—*continued.*

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
	JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD, 230 LB.			
Trecarne Jersey Maid	T. A. Petherick, Lockyer	4,852·4	255·704	Trecarne Victor
Queen of Toowoomba	C. W. Barlow	3,914·17	241·642	Trecarne Golden King
Curramore Marina	F. M. Burnett, Curramore	4,566·55	236·443	Norwood of Raleigh
Lermont Jeannette (268 days)	J. Schull, Oakey	4,573·8	231·835	Lermont Noble
Lermont Kate (268 days)	J. Schull, Oakey	4,459·5	231·434	Lermont Noble
Trecarne Colleen (268 days)	J. Schull, Oakey	3,894·9	230·849	Trecarne Barley King
	AYRSHIRE.			
	MATURE COW (OVER 5 YEARS), STANDARD, 350 LB.			
Fairview Ode	R. M. Anderson, Southbrook	10,277·28	388·801	Longlands Bonnie Willie 2nd
	SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD, 250 LB.			
Myola Jollity	R. M. Anderson, Southbrook	8,711·63	395·712	Longlands Bonnie Willie 2nd
	GUERNSEY.			
	JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD, 230 LB.			
Laureldale Olga	W. A. Cooke, Maleny	6,230·65	344·589	Linwood Favour
	FRIESIAN.			
	MATURE COW (OVER 5 YEARS), STANDARD, 350 LB.			
Towerlton Viola	F. C. Noller, Kumbia	11,641·15	404·048	Swastika of Towerlton
	AUSTRALIAN ILLAWARRA SHORTHORN.			
	MATURE COW (OVER 5 YEARS), STANDARD, 350 LB.			
Kyahram Marie	A. H. Black, Kumbia	13,783·35	597·183	Ledger of Greyleigh
Evelyn of Altavale (206 days)	W. H. Thompson, Nanango	11,870·4	505·539	Reward of Fairfield
Gentle 15th of Greyleigh	W. H. Thompson, Nanango	11,851·8	474·067	Gordon of Swanl a
Cameo of Braemar	A. H. Black, Kumbia	10,891·55	452·201	Victory of Balmoral

Blacklands Lady Ettie 3rd	A. B. Spiers, Wiyarra	8,630·2	418·762	Sultan the Second of Blacklands
Blacklands Ethel	A. Pickels, Wondai	10,558·8	400·591	Red Prince of Blacklands
Lorna of Greenfields	S. Henry, junr., Chatsworth	11,371·85	399·82	..
Thornleigh Pet 10th	C. O'Sullivan, Greenmount	10,609·5	382·381	Fussy's Pride of Fairfield
Waverley Fussy	R. A. Scott, Toogoolawah	8,466·35	354·231	Waverley Larry

SENIOR, 4 YEARS (OVER 4½ YEARS), STANDARD, 330 LB.

Model 3rd of Alfavale (365 days)	W. H. Thompson, Nanango	16,373·95	700·394	Reward of Fairfield

JUNIOR, 4 YEARS (UNDER 4½ YEARS), STANDARD, 310 LB.

Star 2nd of Alfavale	W. H. Thompson, Nanango	15,009·85	645·636	Reward of Fairfield

JUNIOR, 3 YEARS (UNDER 3½ YEARS), STANDARD, 270 LB.

Navillus Plum	C. O'Sullivan, Greenmount	8,687·8	380 225	Midget Shiek of Westbrook
Home Hill Gem	E. O. Althouse, Cloyna	9,687·17	360·213	Headlands Gordon
Home Hill Rose	E. Althouse, Cloyna	9,221·65	344·399	Headlands Gordon

SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD, 250 LB.

College Doreen	Queensland Agricultural High School and College, Gatton	9,516·84	385·823	Premier 2nd of Hillview
Glenore Princess	A. M. Johnson, Gracemere	7,683·9	302·035	Sunnyview Union Jack
Applegarth Calm	A. B. Spiers, Wiyarra	7,265	255·595	Duchess Jellicoe of Fairfield

JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD, 230 LB.

Headlands Dolly 4th	Burnett Bros., Brookfield	10,317·2	413·515	Bruce of Gunvallis
Modern Favourite	R. Mears, Toogoolawah	7,856	340·778	Modern Stirling
Home Hill Nala 3rd	E. Althouse, Cloyna	8,647·65	307·572	Headlands Gordon
Euroa Bess	H. T. Lindenmayer, Mundubbera	8,178·41	295·488	Swagman of Clonagon
Melmerle Shadow	S. L. Holmes, Goomburra	6,521·3	275·955	Wunulla Utility

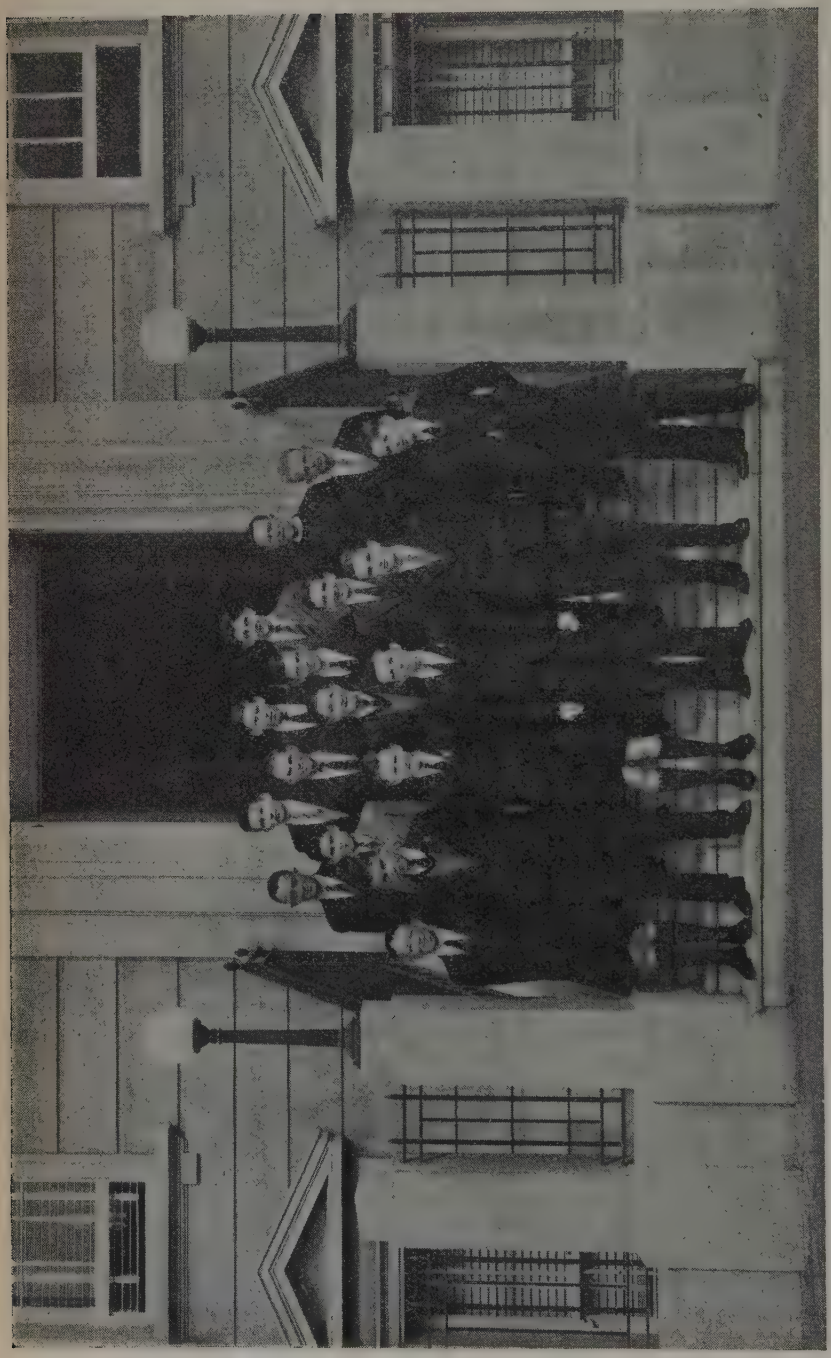


PLATE 43.

SCIENCE MEN OF TO-MORROW.

Group of Scholars from the Christian Brothers' College, Gregory Terrace, Brisbane, on the occasion of an instructional tour of the Laboratories of the Department of Agriculture and Stock. Rev. Brother R. Watson is the teacher in charge.

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Port Curtis District Plants Identified.

L.G.D. (Rosedale)—

1. *Cyperus Iria.* A sedge.
2. *Persoonia virgata.* One of the geebungs.
3. *Centauria melitensis.* Cockspur thistle or star thistle. A very common weed on the Darling Downs, and, generally, is a much more serious pest in Southern States than in Queensland.
4. *Euroschinus falcatus.*
5. *Linociera ramiflora.*
6. *Baeckea virgata.*
7. *Indigofera linifolia.*
8. *Amarantus interruptus.* A common little amaranth for which we have not heard a local name. We are surprised to hear that neither stock nor poultry take to it for green feed. We have cooked and eaten it ourselves, and found it quite a good substitute for spinach.
9. *Pseudomorus Brunoniana.*
10. *Malvastrum tricuspidatum.* A very common weed in Queensland for which we have heard no common name. It is usually called *Sida retusa,* which, of course, it is not, although it is closely allied to it.
11. *Olea paniculata.*
12. *Eranthemum variable.* Sometimes called love flower.
13. *Moschosma polystachyum.*
14. *Lespedeza cuneata.* It is rather interesting to hear that horses eat this plant. It is very closely allied to *L. sericea* which has been boomed as a fodder, under the name of Korean Clover, although it seems rather woody.
15. *Thesium australe.*
16. *Canthium coprosmoides.*
17. *Arytera divaricata* (*Nephelium divaricatum*).
18. *Chilocarpus australis.*
19. *Digitaria marginata* aff.
20. *Chloris ventricosa.*
21. *Arundinella nepalensis.*
22. *Paspalum distichum.* Water. couch. An excellent stock grass but a terrible pest in cultivations, particularly in damp situations.
23. *Danthonia sp.?* There are only glumes left and it is rather difficult to be sure without a complete spikelet.

A Poisonous Plant. Red Natal Grass. A Yam.

"Sap" (Townsville)—

1. The red prune-like fruit is *Ochrosia alliptica.* The tree is very common along the coast of North Queensland, but we have not heard a local name. The fruits are red and attractive but poisonous.
2. The samples of grass represent red Natal grass, *Rhynchelytrum repens.* Introduced into Queensland many years ago, and now very widely spread in the coastal parts of the State. In South Queensland it is very common as a weed on the fruit farms, and is used with some success, particularly when mixed with better fodders, as a chop chop for cattle and working horses. It is of annual duration, and once introduced into the locality generally spreads naturally very rapidly.
3. The third specimen is a variety of *Dioscorea bulbifera* or yam. The edible qualities of the aerial tubers produced vary very considerably. If the tuber is cut and it turns brown rather quickly, it is generally regarded as unfit for use, in fact rather dangerous. It is often very easy to grow and has quite an ornamental foliage. Otaheite or Tahitian Potato is a name sometimes given to it.

Roma Specimens Identified.

W.T.C. (Roma)—

1. *Tribulus terrestris.* Caltrops, also known as cat head, goat head, bull head, &c., names loosely applied to a number of burr plants in Queensland. It is very common throughout the whole of Western Queensland and is not known to cause any trouble here.
2. *Boerhaavia diffusa.* Tar vine, a very common weed in Queensland and generally regarded as quite good fodder for stock.
3. *Euphorbia Drummondii.* Caustic creeper. This plant is very common in many parts of Queensland and is widely spread through most of the Australian States. We have very little trouble with it with ordinary paddock resting stock in Queensland, but occasionally severe losses among travelling stock are reported. In New South Wales a prussic acid yielding glucoside has been found in the plant, but tests in Queensland have always given negative results. The symptoms stated by experienced drovers are that the head and neck of the affected animals, principally sheep, swell up very considerably and if the swelling is pierced an amber coloured fluid exudes and the life of the animal may be saved.
4. *Crotalaria dissitiflora.* A species of rattle pod very common in Queensland. Although some species of rattlepods both in Australia and abroad have been proved definitely poisonous to stock, nothing particularly is known about the present species. It is exceedingly common throughout the Maranoa and Western Queensland generally and is not known to possess any poisonous properties.
5. *Trianthema crystallina.* A plant allied to pig weed. It is very common and is generally regarded as quite a good fodder.
6. *Swainsona oroboides.* This plant is allied to the Darling pea, but is not known to possess any poisonous properties.
7. *Santalum lanceolatum.* This is the true sandalwood, but only the bigger trees have a good scented heart wood. It is very different from the so-called sandalwood of the Maranoa district, and is more frequently known as plum wood or Damson. The leaves are generally regarded as being quite good fodder for stock.

Murgon District Grasses Identified.

H.S. (Silverleaf State School, via Byee)—

1. *Echinochloa Walteri.* A wild millet. This tall grass is usually found in swampy situations and is generally regarded as a good fodder. It is closely allied to such well known cultivated crops as Japanese millet and white panicum.
2. *Arundinella nepalensis,* sometimes called rush grass. It can hardly be called a good fodder.
3. *Eulalia fulva.* Brown top. It is closely allied to the blue grasses and is quite a good fodder.
4. *Fimbristylis sp.* A sedge, not a true grass.
5. *Tragus racemosus.* Small burr grass.
6. *Brachiaria foliosa.* Leafy panic grass. This grass is fairly common in Southern Queensland and is usually regarded as quite a good fodder for stock.

5. *Tragus racemosus.* Small burr grass.

7. *Eragrostis cilianensis.* Stink grass. See reply to J.F. (Longreach).
8. *Eragrostis Brownii.* A love grass. This grass has no particular properties, but is quite common in the average native mixed pasture.
9. *Capellipedium parviflorum.* Scented top.
10. *Bothriochloa decipiens.* Bitter or pitted blue grass. This is also known in New South Wales as red leg. This grass is very common in some heavily grazed pastures, springing up where the better grasses have been eaten out. As cattle seem to leave it untouched, it soon gets a hold in the pasture.
11. *Sporobolus elongatus.* Rats tail grass.
12. *Stipa verticillata.* Bamboo grass. In spite of its rather cany stems, this grass seems to be eaten readily enough by stock.
13. *Eragrostis parviflora.* Weeping love grass.

General Notes

Staff Changes and Appointments.

Messrs. H. Lambert, R. J. Rollston, and F. C. Jorss have been appointed Assistant Inspecting Cane Testers for the forthcoming sugar season, with headquarters at Cairns, Mackay, and Maryborough, as from the 8th June, 1st July, and 1st July, respectively.

Mr. Thomas Mee, Clerk of Petty Sessions, Nambour, has been appointed Chairman of the Moreton Local Sugar Cane Prices Board in lieu of Mr. T. P. Shanahan, and also an Agent of the Central Sugar Cane Prices Board for the purposes of making inquiries in regard to sales and leases of assigned lands.

The following have been appointed Honorary Rangers under the Animals and Birds Acts:—

Messrs. C. H. Griggs (Giru), E. R. Marshall (Yuruga), W. D. McCloskey (Giru), and T. G. Peebles (Toobanna); L. Opperman (Ormeau), H. B. White (Percy Island), and W. M. Featherstone and A. H. Stone (Katoomba, Toowoomba).

Acting Sergeant T. Quinlan, Roma, has been appointed also an Inspector under the Brands Acts.

The Officer in Charge of Police at Stanthorpe has been appointed also an Acting Inspector of Stock.

Constable W. J. Randle, Roma, has been appointed also an Inspector under the Slaughtering Act.

The following officers of the Department of Agriculture and Stock have been appointed also collectors of royalty in the current opossum season:—

Messrs. S. E. Stephens, Instructor in Fruit Culture, Cairns; H. Coffey, Inspector of Stock, Mackay; D. Hardy, District Inspector of Stock, Emerald; W. D. C. McNeill, District Inspector of Stock, Toowoomba; W. C. Woodhouse, District Inspector of Stock, Maryborough; S. A. Green, Inspector of Stock, Wallangarra; and J. L. Bowman, District Inspector of Stock, Brisbane.

The undermentioned have been appointed honorary rangers under the Animals and Birds Acts in Northern sugar districts. They include members of the Pleystowe Mill Suppliers' Committee, the Victoria and Macknade Mill Suppliers' Committee, and the Herbert River District Executive:—

Messrs. W. A. Lyon (Macknade), H. Clay (Hawkins Creek, Ingham), T. J. McMillan (Bemerside), J. Miguel (Ingham), B. Parravicini (Halifax), F. Pavetto (Macknade), H. J. Hollins (Fairford, Ingham), L. L. Palman (Victoria Estate, Ingham), G. M. S. Robino (Victoria Estate, Ingham), J. A. Row (Stone River, Ingham), R. Smith (Long Pocket, Ingham), E. Kean (Habana), M. W. R. Bowman (Pleystowe), A. Breadsell (Pleystowe), J. Griffiths (Mirani West), A. Kippen (Wundaru), T. Madigan (Wallingford), W. Holding (Mount Pelion), R. Young (Walkerston), and C. McKinley (Walkerston).

Messrs. F. Prentice (Southbrook), S. R. Hockings (Toowoomba), and A. J. Lavender (Toowoomba), members of the Jondaryan Shire Council, have been appointed honorary rangers under the Animals and Birds Acts and the Native Plants Protection Act.

Mr. R. B. Morwood, M.Sc., Pathologist, Department of Agriculture and Stock, Brisbane, has been transferred to Toowoomba.

Mr. P. C. Boettcher (Annerley) and Mr. C. M. Martin (North Bundaberg) have been appointed assistant cane testers at the Kalamia and Isis Sugar Mills.

Sergeant A. Bahr, Blackall, has been appointed also an inspector under the Brands Acts.

Mr. N. F. Brincat, of Stockton, near Innisfail, has been appointed an honorary ranger under the Animals and Birds Acts.

Mr. J. L. Luke, Glen Aplin, has been appointed an honorary ranger under the Animals and Birds Acts and the Native Plants Protection Act.

Members of the Goondi Pest Destruction Board, listed as under, have been appointed honorary rangers under the Animals and Birds Acts:—

Messrs. K. W. Maclean, R. T. Easterby, and J. R. Kerr (C.S.R. Co., Ltd., Goondi), W. C. Ah Shay (Mourilyan), W. J. Burke (Innisfail), H. Klarwein (Daradgee), A. Griggs (Innisfail), J. Kallaris (Daradgee), H. T. Stone (Innisfail), F. Wilderspin (Innisfail), and T. Bacalakis (Garradunga).

Mr. B. B. Brett, Manager of Mount Sturgeon Station, Hughenden, has been appointed an honorary ranger under the abovementioned Acts.

Mr. F. Caine, Inspector of Stock, Ipswich, has been appointed also an Inspector under the Dairy Produce Acts.

Mr. W. T. Gettons, Sub-Accountant of the Department of Agriculture and Stock, has been appointed Accountant to the Department in succession to Mr. S. S. Hooper, who retired under the age limit conditions on the 30th June. Mr. Gettons joined the Department in 1910, and entered the Accounts Branch the following year. He was appointed Sub-Accountant in 1920. He has also been Registrar of Farm Produce Agents since 1919, and a temporary member of the Central Sugar Cane Prices Board since 1934. He became a member of the Australian Institute of Commonwealth Accountants on the formation of that body in 1920. Messrs. V. F. J. Bohan, E. C. R. Sadler, E. F. Keefer, and J. R. Winders secure consequential promotions in the Accounts Branch of the Department following on Mr. Gettons' appointment to the position of Accountant.

Acting Sergeant D. A. Campbell, Nambour, has been appointed also an Inspector under the Slaughtering Act.

Mr. G. F. E. Clarke, Inspector of Dairies, Ipswich, has been appointed also an Inspector under the Diseases in Stock Acts.

The Officers in Charge of Police at Chinchilla and Terror's Creek have been relieved of the positions of Caretaker of the Chinchilla Dip and Acting Inspector of Stock, respectively.

The Officer in Charge of Police, Mount Molloy, has been appointed also an Acting Inspector of Stock.

Acting Sergeants B. C. O'Sullivan (Mareeba), E. A. Puddle (Inglewood), and H. Winter (Thargomindah), and Constable W. C. Swain (Wyandra) have been appointed also Inspectors under the Slaughtering Act.

Mr. O. A. Christensen, junr., of Upper Freshwater, via Cairns, has been appointed an Honorary Ranger under the Animals and Birds Acts.

Preservation of Wild Life.

In order to ensure that the preservation of native animal, bird, and plant life is maintained a number of Land Commissioners, Land Rangers, and Forest Officers stationed in various parts of the State have been appointed also Honorary Rangers under the Animals and Birds Acts and the Native Plants Protection Act.

Northern Stallion District.

A Proclamation has been issued under the Stallions Registration Acts altering the boundaries of the Northern Stallion District so as to bring the Acts into force in the Petty Sessions District of Cape River. The Northern Stallion District now consists of the Petty Sessions Districts of Ayr, Cape River, Charters Towers, Ravenswood, and Townsville.

Regulations Relating to Fineness of Bone Dust.

Executive approval has been given, under the Fertilisers Act, to the amendment of a Regulation to provide that the size of the aperture of the sieve used for determining the fineness of bone dust shall be one-tenth of an inch square instead of one-sixteenth of an inch square.

Fruit Marketing Regulations.

Executive approval has been given to the repeal of all regulations previously made under the Fruit Marketing Organisation Acts and to the issue of new regulations in lieu thereof. These regulations do not embody any new principles; they are merely a reissue of all regulations at present in force, those which have expired by effluxion of time having been eliminated.

Extending Operations of Canary Seed Board.

An Order in Council has been issued in pursuance of the provisions of "*The Primary Producers' Organisation and Marketing Acts, 1926 to 1935,*" extending the operations of the Canary Seed Board for the period as from 1st June, 1936, to 31st May, 1939.

Davenport Downs—Palparara Holdings Road a Stock Route.

An Order in Council has been issued in pursuance of the provisions of the Diseases in Stock Acts, declaring the Davenport Downs-Palparara Holdings road, in the Jundah Land Agent's District, to be a stock route for the use of travelling stock.

Control of Brumbies in the Charters Towers and Cape River Districts.

A Proclamation has been issued under the Diseases in Stock Acts declaring the Petty Sessions Districts of Charters Towers and Cape River, in the Townsville Stock District, to be a district for the control of "brumbies," or wild horses, for the period from 1st August, 1936, to 30th November, 1936.

Unregistered Apiaries.

It has been reported to the Department of Agriculture and Stock that several beekeepers are failing to register their apiaries as provided for in "*The Apiaries Act of* 1931." A conviction has recently been obtained for this offence, and it is understood that further prosecutions are pending.

The Brisbane Show.

The organisation of the 1936 Queensland Royal National Show, to be held at Bowen Park, 17th to 22nd August, is rapidly nearing completion. An extensive works programme, involving an expenditure of some £20,000, has just been completed, and comprises important additions and improvements to the permanent Showground assets which will rank Bowen Park as one of the most modern and replete showgrounds in the Commonwealth.

The Show offices are already inundated with entries from all parts of the State for the various sections, and it is confidently anticipated that the various live stock sections will equal, if not eclipse, those of previous years. Live stock exhibitors who intend to leave with their teams of cattle prior to the date on which Excursion Railway fares would ordinarily apply are reminded that they should apply to the Secretary, Mr. H. W. Watson, Royal National Association, Courier Building, Queen street, in order that voucher certificates may be issued for presentation to the local station-master.

All further particulars may be obtained on communicating direct with the Secretary.

Appointment of Cane Testers.

The following have been appointed cane testers in pursuance of the provisions of the Regulation of Sugar Cane Prices Acts for the forthcoming sugar season at the mills indicated:—

Messrs. G. E. Becker (Babinda), C. J. Boast (Farleigh), T. Breen (Inkerman), T. P. Brown (Maryborough), J. Casey (South Johnstone), L. Chadwick (Mourilyan), P. H. Compton (Mulgrave), T. F. Corbett (Millaquin), T. D. Cullen (Bingera), L. G. F. Helbach (Proserpine), L. C. Home (Pioneer), J. Howard (Rocky Point), C. H. Humphreys (Cattle Creek), C. H. Jorgensen (Horston), J. Macfie (Racecourse), W. Richardson (Mount Bauple), G. Tait (Pleystowe), F. W. Trulson (North Eton), H. T. Whitcher (Invicta), R. D. Woolcock (Kalamia), V. F. Worthington (Plane Creek).

Misses D. Bowder (Mossman), E. Christsen (Marian), A. L. Levy (Qunaba), J. O'Flynn (Moreton), J. Orr (Tully), I. Palmer (Fairymead), M. T. Smith (Isis).

The following have been appointed assistant cane testers under the Regulation of Sugar Cane Prices Acts for the forthcoming sugar season at the mills indicated:—

Messrs. R. Anderson (Millaquin), C. Boone (Pioneer), A. Byrne (Bingera), E. J. Delaney (Plane Creek), St. C. G. Fanning (Tully), H. L. Holthouse (Pioneer), A. R. Hughes (Invicta), H. A. Laurie (Kalamia), R. A. Mahoney (Proserpine), S. McRostie (Isis), L. C. J. Clifton (Marian), J. Y. Taylor (Racecourse), P. A. Van Lith (Cattle Creek), D. Walton (Proserpine).

Misses D. Aldridge (Bingera), A. Anderson (Moreton), A. L. Dahl (Invicta), P. Eadie (Plane Creek), F. Foubister (Racecourse), N. Hooper (Pleystowe), C. Humphreys (North Eton), M. A. Lyle (South Johnstone), M. Morris (Pleystowe), T. M. Payne (Maryborough), E. Rowe (Marian), P. Southwick (Qunaba), M. Thorburn (Millaquin), M. E. L. Wassell (Babinda), S. Wilkinson (Farleigh), and Mrs. M. E. Nally (Inkerman).

Rural Topics

British Pedigree Pigs.

The National Pig Breeders' Association of Great Britain (Victoria House, Southampton Row, London, W.C.1, England) advises that it will be pleased to send to any pig breeder in Australia illustrated literature about British pigs, also specimen copy of "Pig Breeders' Gazette" (issued quarterly, price 9d. post free, annual subscription 3s.). The N.P.B.A. also issue "Pig Breeders' Annual" (3s. per copy post free), a book for breeders throughout the world. Write the secretary above address.

Good Feeding Essential.

In a two-minute talk with the secretary of the Friesian Association, it was gathered that during a recent tour amongst breeders of the Black and Whites in the South Island, Mr. Kalaugher had been tremendously impressed with the value of adequate feeding. "Good breeding is a great factor," he said, "but good feeding is equally essential." Mr. Kalaugher found that the dairy farmers, whose herds recorded the highest average milk and butter-fat returns, were invariably the farmers who fed their cows in the most liberal fashion, and with the most suitable rations. Professor Wilber J. Fraser, of the University of Illinois, recently contributed a striking article on "The Forlorn Cow," and declared that a general survey of dairy farms in the eastern half of the United States revealed the terrible underfeeding of thousands of thin dairy cows. Sixty per cent., he said, were underfed. The professor had counted in Illinois and Wisconsin the thin cows in a total of 234 herds containing 4,235 cows, 2,548, or 60 per cent., of which were too thin to do their best work. One year 62 per cent. of the cows counted were too thin in sixty-four dairy herds containing 1,000 cows. In the best-fed fourth of these herds only 16 per cent. of the cows were too thin, whereas in the poorest-fed fourth, 99 per cent. were too thin to do their best work. In fourteen herds, or 21 per cent., every cow was too thin. Yet the owners of both well-fed and poorly-fed herds had practically the same conditions for producing feed. The difference in the flesh and production of the cows was due almost entirely to the way they were fed—or starved.

Improved breeding, says the professor, has given us higher producing, more potentially profitable cows than we ever had before. But what is the use of all this effort and expense to get better producers if we don't feed two-thirds of them enough to allow them to produce abundantly. Apparently many dairymen think that, as soon as they give a cow some feed they get some milk from that feed, and, as quick as they get some milk they think that they get some profit from that milk. Nothing could be farther from the truth. Every cow on earth must use the feed required for maintenance first, because she cannot live if she does not have the nutriment necessary to support her body, and this requires far more feed than most farmers realise. Cows are kept for profit, and yet there is no profit under average farm conditions until a cow has produced 4,000 lb. 4 per cent. milk, or 160 lb. fat, to pay for all expenses of the cow, her feed, care, and housing up to this production. After this production is reached, two-thirds of any milk and fat produced above this goes for clear profit, under ordinary farm conditions.

As Mr. Kalaugher truly remarked in the two-minute conversation referred to, the best feeders in New Zealand get the biggest returns. That is the experience in every country under the sun. "Breed, weed, and feed," is a slogan that should be pasted in the hat of every dairy farmer.—From "Things We Talk About," by "Himi" in "The New Zealand Farmer."

Shearing Records.

The record for blade shearing is credited to Jack Howe, who, at Alice Downs Station (Queensland) in 1892, shore 321 sheep. In the same or following year he shore 276 sheep with machines at Barcaldine Downs Station (Queensland). The next tally of importance, and which is probably one of the highest, if not the highest, in Australia, was Dan. Cooper's performance at Bundooran Station (Queensland) in 1910, when he shore 316 sheep with machines in eight hours and ten minutes. The record for one day at any individual shed was at Brookong (N.S.W.), where, in 1902, approximately 170,000 sheep were shorn, the daily tally being over 10,000 and the highest tally 10,361.—"The Australasian."

Orchard Notes

AUGUST.

THE COASTAL DISTRICTS.

IN many centres the bulk of citrus fruits, with the exception of the late-ripening varieties, will have been harvested, and cultural operations should be receiving attention.

Trees which show indications of impaired vigour will require a somewhat heavy pruning, both in respect to thinning and shortening the branches. Where the trees are vigorous and healthy a light pruning only will be necessary, except in the case of the Glen Retreat mandarin. The densely-growing habit of this variety leads to a profusion of weak shoots, which, if allowed to develop, will be responsible for overbearing and resultant small and inferior fruit at an early age.

Where trees show signs of failing, investigations should be made at or near ground level for the presence of collar rot. The roots should be examined for disease, and in the North Coast districts for the presence of the citrus root bark channeller. A light application of paradichlorobenzene buried a few inches deep in circular drills around the tree and with the surface stamped firmly has been recommended for controlling this pest. The distance between the circular drills should be not more than 18 inches, and care should be taken to prevent the crystals of paradichlorobenzene from coming into contact with the roots. It may be necessary to repeat the application after an interval of three or four weeks.

Where it is necessary to control Black Spot, Melanose and Scab, the fungicide should be applied at the correct time. The control measures recommended are—

For Black Spot.

Bordeaux of 3-2-40 strength or Bordeaux of 3-2-40 strength + 1 per cent. of oil emulsion—

(1) As soon as the fruit has set;
(2) About a month to six weeks later;
(3) If Black Spot has been serious previously, another application just prior to the February rains.

For Melanose.

The use of a similar fungicide—

(1) Immediately the fruit has set;
(2) A month to six weeks later, or more often if the weather conditions are exceptionally wet.

For Scab.

(1) Bordeaux mixture 6-4-40 or Bordeaux 6-4-40 + 1 per cent. oil emulsion immediately before the new growth commences; this will help to clean up fungus on the old scabs;

(2) Bordeaux 3-2-40 or Bordeaux 3-2-40 + 1 per cent. oil emulsion at about the middle of the flowering period; this and subsequent applications are for the protection of young foliage and fruit;

(3) Bordeaux as soon as the fruit has set;

(4) If the season is exceptionally wet, it is advisable to give one or two further applications in order to keep the young fruit and foliage well covered.

Where for any reason healthy trees of vigorous constitution are unprofitable, they may be headed back—in fact, have the whole of the top removed—leaving a few selected arms. All other branches should be cut away at their source of origin. The three or four remaining arms, whose lengths will vary from 2 to 4 feet, will form the future framework of the tree. Care must be taken to cover the whole of the exposed bark with a suitable coating of whitewash to prevent sunburn. The numerous shoots which will grow from the main arms are suitably reduced, leaving from two to four on each arm. Under favourable conditions these will be in a fit condition to receive selected buds from desirable trees by the following autumn.

It is desirable that, when shoots intended for budding have attained a length of from 6 to 9 inches, their terminals should be nipped off in order to stiffen their growth and guard against the possibility of damage by strong winds.

Fertilizing should be completed as early as possible, the mixture for the spring application being high in readily available nitrogen. Ploughing should then be completed, the depth of which will be regulated by local conditions and the nature of the original preparation of the land. Following upon the ploughing the land should be worked down to a fine state of tilth. On hillside orchards attention should be given to the care of possible storm waters. Cultivation should be so arranged as to form shallow drains or banks along the tree rows and across the heaviest slope, leading into suitable side drains which may be grassed to prevent erosion.

The planting of trees may be continued and, with the exception of custard apples, expedited. The attention of citrus growers should be confined to varieties suited to their local conditions.

The pruning of grape vines should be completed, and where cuttings for planting are required these should be selected, trimmed, and heeled-in in slightly dry soil. Canes intended for cuttings should not be allowed to lie about and dry out, but should be treated the day they are severed from the plant. Cuttings are frequently made of excessive length; however, from 10 to 12 inches is a suitable length which allows for insertion in the soil so as to permit of the top bud, with a short section of the internode, protruding above the surface.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

ALL pruning other than that applied to peaches and varieties which are late in coming into growth should be completed this month, and the planting of young trees, if not already done, should no longer be delayed. Early planting is preferred, the sooner after the fall of leaves the better. The time is opportune (when there is indication of the buds swelling) to work over (where the stock is reasonably vigorous) unprofitable trees. Strap grafting, as advised by the local field officers, is the most satisfactory method of top-working deciduous trees.

The pruning of vines should be postponed as long as circumstances permit, and these can only be gauged on actual observation as they are subject to much variation.

The usual winter working of the land is essential for the retention of moisture and aeration of the soil, but in shallow soils in which many orchards are planted deep working is most detrimental. The matter of seedling stocks for apples and the inferior plants frequently received from Southern nurseries prompts a query as to how many seeds have been stratified for spring planting, and if any effort is being made towards raising a local supply of nursery stock.

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Farm Notes

AUGUST.

THE most important work during August will be the preparation of the land for all spring-sown crops. The better the cultivation the better the results that can be expected. Potato planting will be in full swing this month, and in connection with this crop the prevention of diseases calls for special attention. Where possible, seed potatoes should be selected from localities which are free from disease; they should be well sprouted, and, if possible, should not exceed 2 oz. in weight. Seed potatoes of this size are more economical to use then those large enough to necessitate cutting. However, if only large-sized seed are procurable, the tubers should be cut so that at least two well-developed eyes are left. The cut surfaces require to be well dusted with slaked lime or wood ashes as soon as possible after cutting. If considered necessary to prevent possible infection by scab, potatoes should be treated with hot formalin or acid corrosive sublimate. Details of the method employed may be obtained from the Department. When treatment has not been carried out prior to sprouting it should be delayed until a day or so before planting. Where cut tubers are to be sown, they should be dipped before cutting.

In localities where all danger from frosts is over, sweet potato cuttings may be planted out. This crop deserves more attention owing to its value for both culinary and stock food purposes.

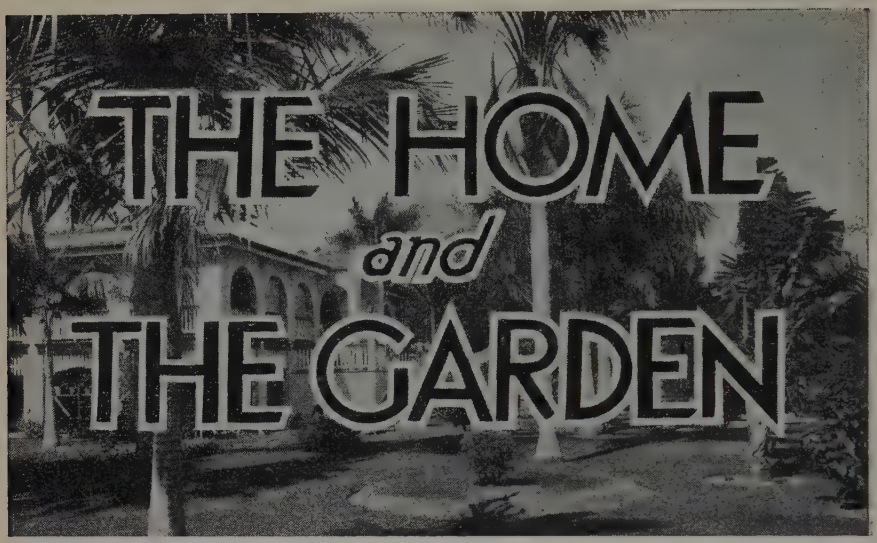
Arrowroot may also be planted this month in suitable localities.

With the advent of warmer weather weed growth will increase, and cultivators will be kept busy in growing crops, and land being prepared for sorghums, millets, maize, cotton, and summer growing crops generally.



PLATE 44.

Coreena Station Homestead, Barcaldine District, Western Queensland.



OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

WINTER INFECTIONS.

DURING the next three months a large number of tourists from the South will visit Queensland to enjoy our glorious winter climate. We do not expect them to come in summer, though our summer heat is not nearly so terrible as many imagine it. Even Queenslanders, for the most part, enjoy the cool change and benefit from it. Their enjoyment would be flawless were it not for the prevalence during that season of the infections commonly called colds, catarrhs, and influenzas. Whether slight or severe, all these may be complicated by serious attacks of bronchitis and pneumonia. The aggregate disablement, expense, and loss of time from these infections are enormous, and they appreciably affect our death rate. The extremes of life—that is, the elderly and the children—among us suffer most.

How These Infections are Spread.

Some protection may be obtained from vaccines, but these are advised chiefly for the elderly. We seldom use them for children. For them the avoidance of infection, as far as possible, is the way of safety. In schools little can be done beyond free ventilation, avoiding only direct currents of cold air, and the free admission of sunlight. For the pre-school child and the infant much might be done by the mother, but owing to lack of knowledge very little is done.

Let us endeavour to supply as much of this knowledge as every mother should possess. These infections are caused by living germs present in the mouth, nose, throat, and air passages. They are spread

mainly by coughing in the form of an extremely fine invisible spray, which floats around the sufferer, until it is dispersed by ventilation. They may be spread also by the moist fingers of young children smearing the secretions of mouth and nose on to the person or clothes of other children. This, like other bad habits, is easily prevented before it becomes a habit. The spread of coughing is less easily controlled.

Massive Infections.

Whether exposure to infection will cause illness depends on two things—the massiveness of the infection and the resistance of the person attacked. By massiveness we mean the number of disease germs making the attack; by resistance, the powers of the body attacked to kill or disable the germs, and so render them harmless. With good resisting power a child may resist the infection, unless the dose of the germ is sufficiently large to overcome his resistance.

Prevention of Infection.

These infections are more prevalent in winter, because then we live more indoors, often in closed rooms with little or no ventilation. There is no excuse for this in Queensland. The infections are carried about by persons who have slight attacks, or are recovering from attacks, or though themselves protected, distribute the germs to others. The danger is greatest in crowded ill-ventilated halls, where carriers are sure to be present during an epidemic. It is a very simple and easy thing to keep babies and young children away from indoor crowds.

If a child returns from school with a cold, how seldom is any attempt made to prevent his communicating it to the younger children! The mother may not be able to protect the younger ones from the germs absolutely; but she can do much to diminish the massiveness of the infection.

"Colds" are Not Caused by Cold.

Cold by itself can never cause these infections. This has been well shown by the immunity of those exposed to extreme cold on polar expeditions. Chilling may temporarily lower the resistance, and if the person chilled happens to be a carrier of the infection, may bring on an attack; but this probably rarely happens. The chilly feeling at the commencement of an attack is part of the disease, not its cause. In young children we may always assume that the infection has been received from some other person. Winter infections are not caused by going out into the fresh air, but by sitting in stuffy rooms with other people, one of whom happens to be a carrier.

It must be remembered that once a child has a cold he must be protected from chills, which increase the risk of pneumonia. If he is chilly or feverish, keep him in bed. When he is well, to overclothe him and keep him indoors will only make him more susceptible.

To Increase Resistance.

Good wholesome food containing everything necessary for health, including all the vitamins, is the main thing. The breast-fed infant has more resistance if his mother takes enough milk, wholemeal bread, wholemeal porridge, and green vegetables, together with some butter, cheese, and eggs. The artificially-fed baby should have some codliver oil emulsion, and when he is old enough some cerevite porridge. The toddler should have plenty of milk (one pint daily), wholemeal or cerevite porridge, some butter, egg, fresh vegetables, and fruit. For a delicate child we may add some codliver oil emulsion.

IN THE FARM KITCHEN.

SOUPS.

Cold Weather Recipes.

Stock is the foundation of all soups, so the making is simple. Stock is the liquid obtained from boiling bones in water to draw as much nutriment out of them as is possible. The bones should be broken up and washed, then put into cold water with a little salt; about two quarts of water to two pounds of bones is an average allowance.

Bring the water slowly to the boil, then remove the scum and simmer gently for three or four hours. A flavouring of carrot, onion, and turnip is usually added. These vegetables are washed and prepared and put in whole, after the water has come to the boil.

Veal bones contain more gelatinous matter than either beef or mutton, so veal bones are used for making jellied stock. Fish stock is made from fish bones; vegetable stock from vegetables only; white stock from veal, rabbit, or chicken bones; and brown stock from beef bones. First stock is the liquid obtained from the first boiling, while second stock is the liquid obtained from re-boiling the bones with a second lot of water. Pot liquor is the liquor in which a joint has been boiled. This does not contain as much goodness as stock, but makes a very good foundation for soup. If very greasy, leave it to get cold, then skim off the fat before using it.

Mulligatawny Soup.

Take 1 quart stock, 1 oz. butter, 2 teaspoonfuls curry-powder, 1 tablespoonful flour, 1 turnip, ½ teaspoonful curry-paste, 1 oz. ham, 1 onion, lemon juice to taste, 1 apple,, 1 small carrot.

Peel and cut the onion into rings. Dice ham. Heat the butter in a saucepan. Add onion and ham and fry until brown. Add peeled, sliced apple, scraped, sliced carrot, and diced, peeled turnip. Stir in curry-powder, curry-paste, and stock. Cover. Bring to the boil and simmer very gently for one hour. Rub through a sieve. Thicken with a tablespoonful of flour, mixed until smooth with a little cold water, and stirred very gradually into the soup. Bring to the boil, boil for a few minutes, then serve at once.

Cream of Oats Soup.

Take 1½ pints stock, 6 peppercorns, ½ pint milk, small piece of turnip, 1 onion, ¾ cupful oats, piece of carrot, blade of mace, ½ oz. butter, salt, and pepper.

Melt the butter in a saucepan. Add peeled and sliced onion and carrot. Cook until brown for a minute or two. Carefully add stock, peeled turnip, and herbs. Season to taste with pepper and salt, then add the oats. Cover the pan and simmer for forty-five minutes. Remove from the gas, strain, stir in the milk, gradually reheat, and serve at once.

Haricot Bean Soup.

Take 1 lb. haricot beans, 1 peeled turnip, 2 oz. dripping, 2 tomatoes, 2 large onions, 1 stick celery, 1 pint milk, 2 quarts water, sprig of parsley, pinch of mace, salt and pepper to taste.

Soak the beans overnight in cold water. Next day, drain and add to water with mace, diced vegetables, pepper, and dripping. Bring to the boil and boil for three hours, adding the tomatoes half an hour before the soup is cooked. Rub through a wire sieve. Add milk, minced parsley, and salt to taste. Reheat and serve.

Cock-a-Leekie.

Take 1 boiling fowl, 1 bunch of leeks, 1 carrot, 1 turnip, 1 onion, 2 sticks celery, 3 oz. rice, salt, pepper, 2 bay leaves, 2 quarts cold water.

Wash the leeks and peel the carrot, turnip, and onion. Cut the leeks into four and the other vegetables into dice. Cut up the fowl and put it into a pan with the cold water and one teaspoonful salt. Bring very slowly to the boil and add the vegetables. Simmer very gently for two hours or until the fowl is tender. If it is allowed to boil it will be hard and tough. Remove the fowl and bay leaves. Wash and add the rice and simmer for twenty minutes. Cut the white meat off the fowl and put the pieces in the soup to re-heat. Season with salt and pepper and serve. Water is simmering when a bubble rises now and then at the side of the pan.

Pumpkin Soup.

Take 2 lb. pumpkin, ½ head celery, 1 leek, 2 oz. butter, 1 cupful milk, 1 quart stock, salt, pepper, and a little grated nutmeg.

Cut up the leek, pumpkin, and celery, and put them in the boiling stock. Simmer for one hour and rub through a very fine sieve. Re-heat and add milk, salt, pepper, and nutmeg to taste. Put in the butter and serve.

Rice and Tomato Puree.

Take 1 large tin tomatoes, 1 carrot, 1 onion, 1 pint stock, a few celery seeds, pepper, salt, 2 oz. rice.

Peel and slice the onion. Scrape, wash, and slice the carrot. Wash the rice well. Put all these ingredients into a saucepan, add the tomatoes with their liquor, the stock, and the celery seeds tied up in a small piece of muslin. Season well with pepper and salt. Bring to the boil and cook slowly until the rice and vegetables are quite tender. Stir occasionally to prevent the rice from sticking. Take out the celery seeds and rub soup through a sieve. Rinse out the saucepan, pour the soup back into it, and re-heat. Taste to see if well seasoned, then serve. If the soup is not a good colour, add a few drops of cochineal. If liked, this soup may be thinned down with some more stock.

Vegetable Broth.

Take 1 lb. gravy beef, ½ lb. beef or veal bones, 1 small turnip, 2½ pints cold water, 1 large onion, 1 carrot, 1 clove, 1 bay leaf, salt, and pepper to taste.

Cut the beef into small pieces and place it with the broken bones in a saucepan. Add the water. Stand aside for one hour, then bring slowly to boiling point. Skim and simmer gently for two hours, and strain. Add peeled and chopped onion, carrot, turnip, clove, bay leaf, and seasoning to taste. Cover and simmer till vegetables are tender.

Cream of Pototo Soup.

Take 3 potatoes, 2 slices onion, 1 quart milk, 2 tablespoonfuls flour, ¼ teaspoonful celery salt, 3 tablespoonfuls butter, 1 tablespoonful chopped parsley, salt and pepper to taste, cayenne.

Cook the potatoes until they are soft, then scald the milk and onion in a double boiler. Drain potatoes and add milk after removing the onion. Rub through a sieve, and return to the double boiler over the heat. Melt the butter, add flour, and continue stirring all the time. Pour some of the hot milk mixture over the thickening, then return to the saucepan and cook altogether for five minutes. Lastly add the parsley and seasoning, and serve very hot. If the soup is too thick, dilute it with a little hot water or milk.

Gravy Soup.

Take 1½ lb. shin of beef, 1 carrot, 1 medium onion, 1 stalk celery, 1 tablespoonful cornflour, 1½ quarts water, ½ turnip, 1 oz. butter, 2 bay leaves, pepper and salt to taste, 3 tablespoonfuls water.

Wipe the meat and cut into dice, then place in a saucepan. Pour over the water. Cover and bring to the boil and allow to simmer gently. Fry the sliced carrot, turnip, and celery in the butter (or dripping) till brown, then add to the soup. Put in the bay leaves. Simmer for three hours, then rub through a sieve. Dissolve the cornflour in three tablespoonfuls of water and stir into the soup. Boil four minutes, stirring constantly. Season to taste and serve.

Crecy Soup.

Take 2 bunches of carrots, 2 quarts stock, ½ pint milk, salt, pepper to taste, 1 tablespoonful plain flour, ½ oz. butter.

Scrape the carrots, and cut each into about eight pieces. Melt the fat in a stock pot and add to it the carrots. Fry gently, about 10 minutes, but do not brown the carrots. Then add the stock and simmer till tender (about one hour). Rub all through a sieve, re-heat the puree, then add the milk. Blend the flour to a smooth paste with a little cold milk or stock, stir in with a wooden spoon, and cook gently for about five minutes. Season to taste and serve very hot.

Celery Cream Soup.

Take 1 head celery, 1 pint water or stock, 1 pint milk, salt and pepper, 1 dessertspoonful butter, 1 dessertspoonful sago.

Wash the sago, and put it to soak in the milk. Dice the celery and put on to boil with water or stock and seasoning. Simmer gently for ¾-1 hour, then add the milk, the butter, and sago. Simmer till the sago is clear, then serve.

Kidney Soup.

Take ½ ox kidney or 2 sheep's kidneys, 1 dessertspoonful butter, level tablespoonful flour, ½ onion, 1 quart of good stock, pinch mustard, pepper, and salt.

Peel and dice onion, and skin and dice kidneys. Make the butter hot in a pan, and add the onion. Fry till lightly browned, then add kidney and fry about five minutes, stirring to prevent overbrowning. Add the flour, mustard, and seasoning and fry a few minutes longer. Then add half the stock and stir till the stock boils. Simmer about half an hour, then add remainder of stock, and cook another 20 minutes. If necessary, thicken with a very little cornflour blended with cold water.

Artichoke Soup.

Take 2 lb. artichokes, 1 tablespoonful butter, 1 pint stock, 1 onion, 1 pint milk, 1 heaped tablespoonful flour, 1 blade mace, pepper and salt.

Scrape artichokes and put on to boil in sufficient cold water to cover. Cook till soft enough to be rubbed through a rather coarse sieve. Drain and rub through sieve with a wooden spoon. Heat the milk with the mace and seasoning. Then melt butter, stir in flour till smooth, add the stock, the milk, and last the artichoke puree. Bring to boil and serve.

Cauliflower Soup.

Take 2 quarts stock, 1 white cauliflower, Parmesan cheese, chopped parsley.

Soak cauliflower, then cut into very small pieces. Plunge into boiling water and boil rapidly till quite tender, adding sufficient salt to season. Strain into soup tureen or soup plates, and pour over the stock, which has been well seasoned and brought to the boil. Grate a little cheese over each soup plate of soup, or into the tureen, and add a pinch of chopped parsley to decorate.

Rice Soup.

Take 3 cups chicken or rabbit stock, 1 cup milk, 1 teaspoonful rice, pepper, salt, 1 egg yolk, blade of mace, little finely chopped parsley, shallot or ½ onion.

Wash rice, and cook in sufficient water to cover, till grains are swollen and tender. Drain, pour cold water over, then drain and place in saucepan. Add the stock, the finely sliced onion or shallot, pepper and salt, and cook a little longer, then rub through a sieve. Heat the milk with the mace and seasoning, and pour the milk on to the rice puree. Reheat, and just before sending to table stir in the egg yolk, which has been beaten with a little cold milk. Add the parsley, and serve. Do not boil after addition of egg, as soup will curdle.

Potato Soup.

Take 1 lb. potatoes, 1 large onion, 1 tablespoonful butter, 1 dessertspoonful chopped parsley, 1 tablespoonful flour, 1 quart stock, 1 teaspoonful cream, pepper and salt.

Slice the prepared onion, and fry in the butter (without browning) for 15 minutes or so. Add the potatoes (pared and sliced) and the stock. Bring to boil, skim, and continue boiling till potatoes are tender. Rub through sieve, add seasoning, and reheat. Mix flour with a little cold milk, stir into soup, and just before serving add the cream and the chopped parsley.

IN THE KITCHEN GARDEN.

Should showery weather be frequent during July, do not attempt to sow seeds on heavy land, as the latter will be liable to clog, and hence be injurious to the young plants as they come up. The soil should not be reworked until fine weather has lasted sufficiently long to make it friable. In fine weather get the ground ploughed or dug, and let it lie in the rough until required. If harrowed and pulverised before that time, the soil is deprived of the sweetening influences of the sun, rain, air, and

frost. When the ground has been properly prepared, make full sowings of cabbage, carrot, broad beans, lettuce, parsnips, beans, radishes, leeks, spring onions, beetroot, eschalots, salsify, &c. As westerly winds may be expected, plenty of hoeing and watering will be required to assure good crops. Pinch the tops of broad beans which are in flower and take up peas which require support. Plant out rhubarb, asparagus, and artichokes. In warm districts it will be quite safe to sow cucumbers, marrows, squashes, and melons during the last week of the month. In colder localities it is better to wait till the middle or end of August. Get the ground ready for sowing French beans and other spring crops.

The continued production of rhubarb may be greatly assisted by giving a heavy mulching of manure and hoeing it well into the soil. Keep the beds well watered, and give regularly a dressing of liquid manure, say, once a week.

It is not necessary to use forcing manures on the young stock, as plants are ruined if forced in the early stages of growth.

The rhubarb makes rapid growth during the autumn and spring, and when stalk cutting has been started liquid manuring and manuring may be given.

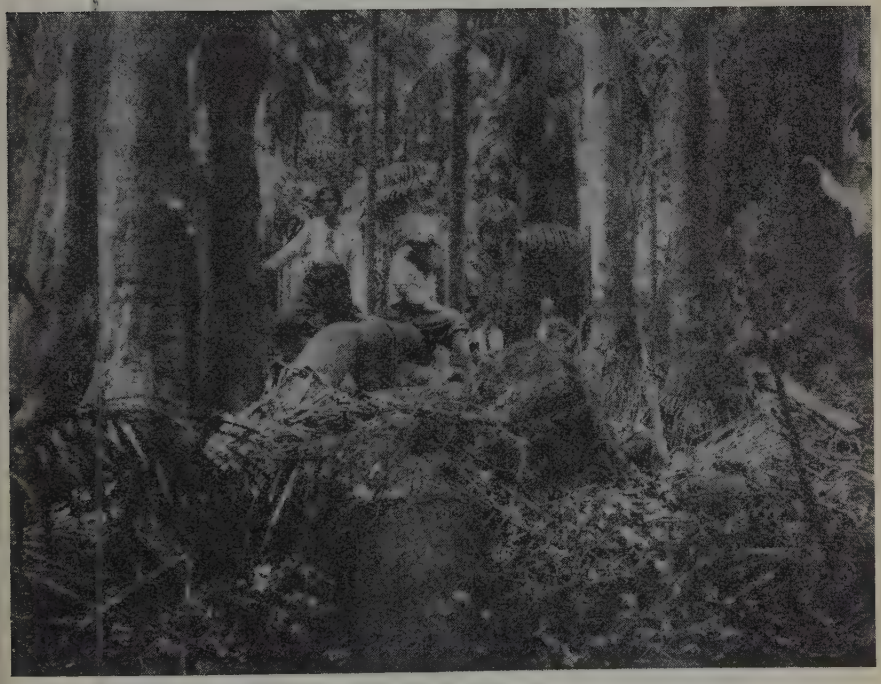


PLATE 45.

Giant scrub box-trees along the bottom of Nixon's Gorge, Lamington Plateau.

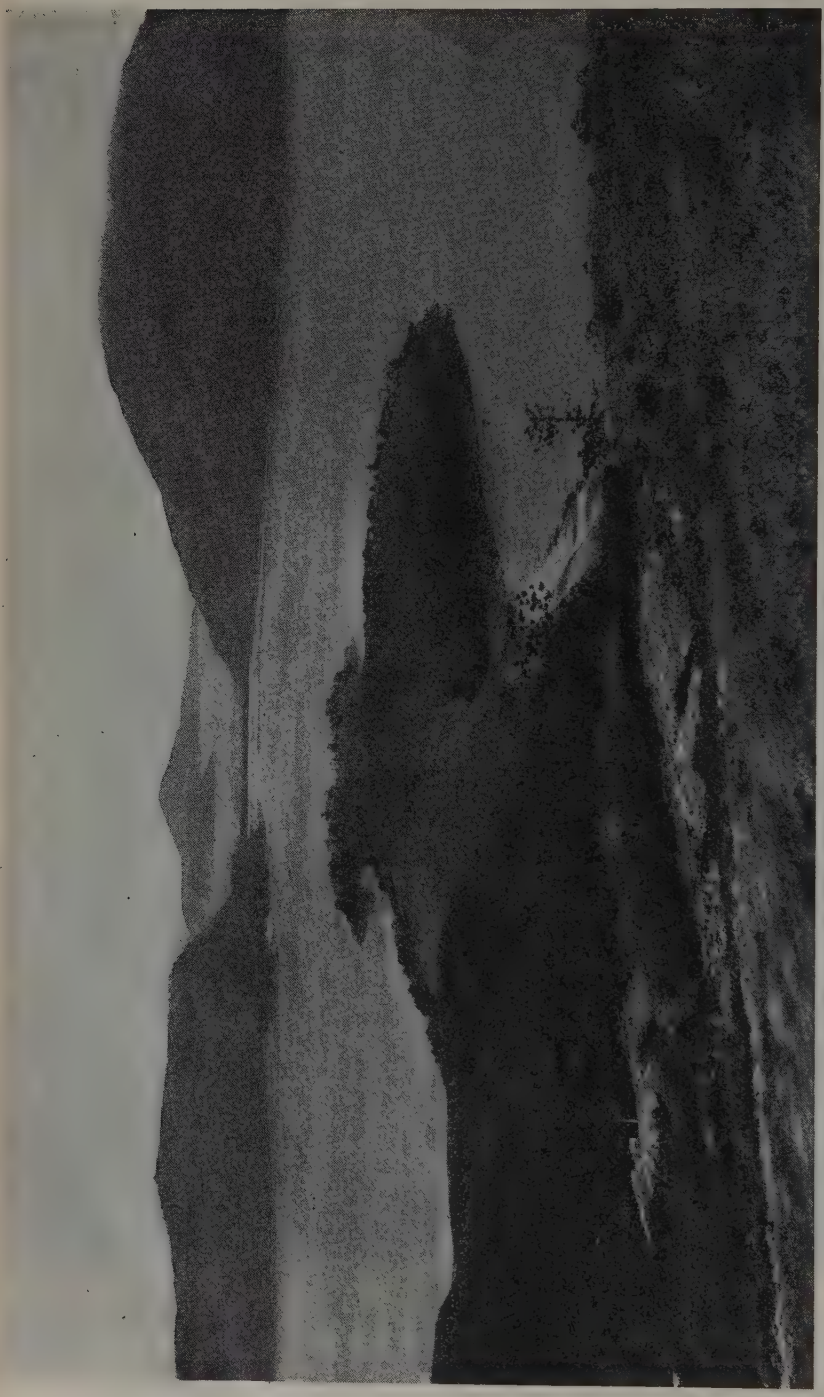


PLATE 46.

Eastern entrance to Kennedy Sound, Whitsunday Passage, from Oldfield's Hill (412 ft.), on Lindeman Island. This scene is typical of the beauty of more than a thousand miles of Coastal Queensland. In these quiet waters innumerable species of edible fish abound.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF MAY IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	May.	No. of Years' Records.	May., 1936.	May., 1935.		May.	No. of Years' Records.	May, 1936.	May, 1935.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	2·24	35	3·47	5·07	Clermont	1·27	65	1·03	0·15
Cairns	4·56	54	4·81	7·52	Gindie	0·88	37	..	..
Cardwell	3·64	64	3·51	4·99	Springsure	1·23	67	1·08	..
Cooktown	2·84	60	3·28	3·53					
Herberton	1·76	50	1·60	4·40					
Ingham	3·68	44	2·69	5·69					
Innisfail	12·54	55	14·49	14·88					
Mossman Mill ..	3·94	23	4·09	7·67	*Darling Downs.*				
Townsville	1·30	65	0·54	2·37					
					Dalby	1·31	66	0·49	1·81
Central Coast.					Emu Vale	1·15	40	0·56	1·10
					Hermitage	1·16	30	..	0·81
Ayr	1·14	49	0·10	1·73	Jimbour	1·22	48	0·31	1·81
Bowen	1·31	65	0·38	1·82	Miles	1·48	51	0·15	0·81
Charters Towers ..	0·80	54	0·38	1·15	Stanthorpe	1·82	63	0·82	1·03
Mackay	3·82	65	4·09	10·80	Toowoomba ..	2·16	64	0·43	1·73
Proserpine	4·41	33	2·61	5·87	Warwick	1·51	71	0·71	0·95
St. Lawrence ..	1·76	65	2·65	1·03					
South Coast.									
Biggenden	1·71	37	1·59	2·55	*Maranoa.*				
Bundaberg	2·58	53	2·91	2·34					
Brisbane	2·75	85	1·14	1·55	Roma	1·38	62	0·23	..
Caboolture	2·78	49	3·82	1·28					
Childers	2·10	41	2·28	1·33					
Crohamhurst	4·81	43	4·42	2·88					
Esk	1·93	49	0·71	1·33					
Gayndah	1·56	65	1·91	1·65					
Gympie	2·81	66	1·71	2·36	*State Farms, &c.*				
Kilkivan	1·81	57	2·80	1·68					
Maryborough ..	2·99	65	2·95	2·54	Bungeworgoral ..	0·85	22	0·06	0·08
Nambour	4·66	40	5·34	2·80	Gatton College ..	1·61	37	0·62	5·13
Nanango	1·52	54	0·96	1·37	Kairi	2·06	22	..	..
Rockhampton ..	1·62	65	1·06	1·09	Mackay Sugar Experiment Station	3·37	39	3·32	8·36
Woodford	2·85	49	2·48	1·65					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—MAY, 1936.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Mean Atmospheric Pressure at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·91	81	67	84	4	52	26	328	15
Herberton	..	71	58	77	5	43	22	160	18
Rockhampton	30·09	79	61	83	14	50	21	106	10
Brisbane	30·17	73	57	80	31	51	29	114	11
Darling Downs.									
Dalby	30·15	75	48	80	12, 13	35	6	51	4
Stanthorpe	..	66	41	77	2	25	20	83	6
Toowoomba	..	70	47	77	9	37	20	43	7
Mid-Interior.									
Georgetown	29·94	85	63	90	12, 13	43	22	47	2
Longreach	30·06	80	53	86	13	41	21	180	4
Mitchell	30·14	74	43	79	12, 13, 14	29	21	53	5
Western									
Burketown	29·94	85	65	91	18	55	21, 22	232	5
Boulia	30·03	80	55	88	10	46	22	321	3
Thargomindah	30·11	75	50	82	1, 10, 11, 12	39	7	68	1

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	July, 1936.		August, 1936.		July, 1936.	Aug., 1936.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					MOONRISE.	
					p.m.	p.m.
1	6·45	5·7	6·35	5·21	2·1	3·26
2	6·45	5·7	6·34	5·22	2·49	4·29
3	6·45	5·7	6·33	5·23	3·43	5·33
4	6·45	5·8	6·33	5·23	4·40	6·38
5	6·45	5·8	6·32	5·24	5·40	7·41
6	6·45	5·8	6·31	5·25	6·43	8·44
7	6·45	5·9	6·31	5·25	7·45	9·47
8	6·45	5·9	6·30	5·26	8·47	10·56
9	6·44	5·9	6·29	5·26	9·50	..
						a.m.
10	6·44	5·10	6·28	5·26	10·53	12·4
11	6·44	5·10	6·28	5·27	11·57	1·5
12	6·44	5·11	6·27	5·27	a.m.	2·8
13	6·43	5·11	6·26	5·28	1·3	3·5
14	6·43	5·12	6·25	5·28	2·8	3·59
15	6·43	5·12	6·24	5·28	3·12	4·44
16	6·43	5·13	6·23	5·29	4·13	5·25
17	6·42	5·13	6·22	5·29	5·11	6·1
18	6·42	5·14	6·21	5·30	6·6	6·33
19	6·42	5·14	6·20	5·30	6·48	7·5
20	6·41	5·15	6·19	5·31	7·31	7·36
21	6·41	5·15	6·18	5·31	8·1	8·9
22	6·41	5·16	6·17	5·32	8·34	8·41
23	6·40	5·16	6·16	5·32	9·6	9·15
24	6·40	5·17	6·15	5·33	9·36	9·52
25	6·39	5·17	6·14	5·33	10·7	10·33
26	6·38	5·18	6·13	5·34	10.40	11·21
						p.m.
27	6·38	5·18	6·12	5·34	11.17	12·13
28	6·37	5·19	6·11	5·35	11·55	1·10
					p.m.	
29	6·36	5·19	6·10	5·35	12·41	2·9
30	6·36	5·20	6·9	5·36	1·32	3·13
31	6·35	5·21	6·8	5·36	2·27	4·17

Phases of the Moon, Occultations, &c.

5 July	○	Full Moon	3	22 p.m.
12 ,,	☽	Last Quarter	10	5 p.m.
19 ,,	●	New Moon	3	14 p.m.
27 ,,	☾	First Quarter	5	22 a.m.

Perigee, 16th July, at 7 a.m.

Apogee, 28th July, at 6·36 a.m.

Jupiter and the Moon will be within 2 degrees of one another at 4 a.m. on the 3rd, when both are about an hour below the eastern horizon.

On the same date the Earth in its orbital revolution round the Sun once a year, will reach its greatest distance attainable from it. Taking 93 million miles as the ordinary distance this will be increased by about 1½ million miles on that date.

On the 6th of July Saturn will cease to move eastward from our point of view and from that time until nearly the end of the year it will apparently have a westward motion, amongst the stars of Aquarius.

A partial eclipse of the Moon will take place in the early morning hours of 5th July. At 2·27 the Moon will enter the Umbra or darker part of the Earth's shadow, which will increase until 3·25 and leave it at 4·24 a.m., about 2 hours before the Sun rises and the Moon sets.

Saturn will be technically in conjunction with the Moon on the 10th, but as it will be 8 degrees from it, more than the length of the Southern Cross, and as it will occur only an hour before midday a popular spectacle cannot be expected.

On the 16th the planets Mercury and Mars will apparently approach one another so closely that they will appear to be touching. However, the Sun rising about half an hour after the planets a flood of daylight will spoil this extraordinary phenomenon.

On the 24th the swift planet Mercury will be in the part of its orbit farthest from the Sun, and so nearly in a line with it from the Earth that it will escape a transit of the Sun's face by only 1 degree 36 minutes; this, however, is more than a diameter and a-half of the Moon. On this occasion Mercury will be almost 1½ times its ordinary distance from the Earth.

A second conjunction of the Jupiter and the Moon in this month will occur on the 30th at 9 o'clock in broad daylight.

Mercury rises at 5·9 a.m., 1 hour 36 minutes before the Sun, and sets at 3.41 p.m., 1 hour 26 minutes before it on the 1st; on the 15th it rises at 6.2 a.m., 41 minutes before the Sun, and sets at 4.23 p.m., 49 minutes before it.

Venus rises at 6.48 a.m., 2 minutes after the Sun, and sets at 5.8 p.m., 1 minute after the Sun on the 1st; on the 15th it rises at 7.2 a.m., 20 minutes after the Sun and sets at 5.31 p.m., 18 minutes after it.

3 Aug.,	○	Full Moon	1	47 p.m.
10 ,,	☽	Last Quarter	6	59 a.m.
17 ,,	●	New Moon	1	21 p.m.
25 ,,	☾	First Quarter	3	49 p.m.

Perigee, 7th August, at 1.48 a.m.

Apogee, 22nd August, at 7.12 p.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

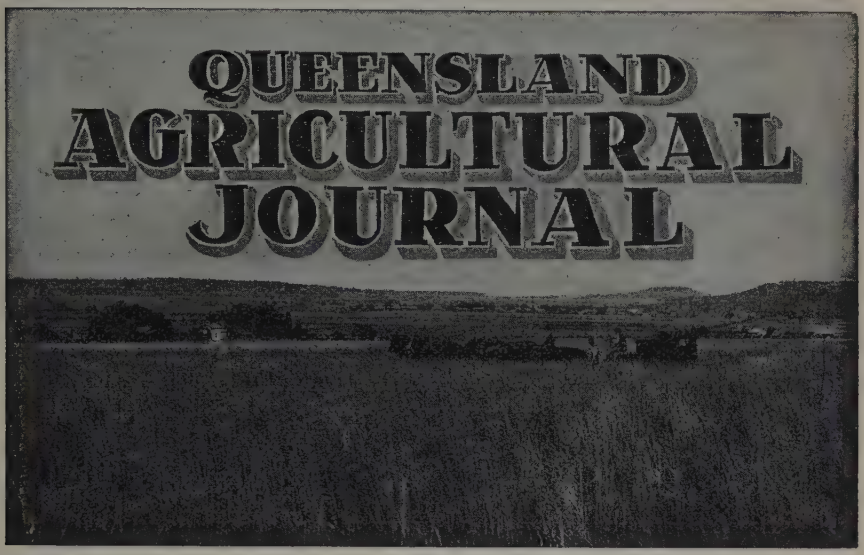
The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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VOL. XLVI. 1 AUGUST, 1936. PART 2

Event and Comment

The Future of the Tobacco Industry.

"I AM hopeful that this Conference represents something more than the mere coming together of officers to discuss the problems of tobacco production without suitable co-operative action being taken to ensure the co-ordination of our separate efforts. I am hoping that the old phrase 'mine and thine' is going to totally disappear from the higher branches of agricultural science, and that a greater degree of close co-operation among the various States will be observed." As expressed by the Minister for Agriculture and Stock, Hon. Frank W. Bulcock, that was the keynote of an interstate conference of scientific and technical officers specialising in tobacco problems, which was held at Brisbane during the last week in July. Dr. T. B. Dickson, chief of the Division of Plant Industry, Commonwealth Council of Scientific and Industrial Research, presided.

Continuing, Mr. Bulcock said that it was considered that of all the technical workers in the Queensland Department of Agriculture, the tobacco staff was engaged in the solution of some of the most complex problems and were employing the most scientific methods in their scheme of research. At this early stage no one could actually say that he had gauged the full value of soil types, and it was hoped that a period of careful experimentation would lead to the full exploitation of soil resources in the production of different qualities of leaf which would produce the blends palatable to Australian tastes.

The Minister referred to certain regrettable things which had hindered the development of the tobacco industry during the recent period of revival in this State. The first was that the result of one year's experiments in certain areas had been regarded as being applicable to general commercial production throughout Queensland; the second had to do with the growth of mushroom manufacturing companies during the early boom period. These small concerns handled practically any and every kind of leaf and supplied the market with a product which had done much to mar the reputation of Australian grown tobacco. In the early days most people would have preferred to cease smoking altogether rather than smoke the Australian leaf. No effort must be spared to destroy this unhappy prejudice which had been set up in the average smoker's mind.

In the matter of soil type determination there was a large amount of work to do, and Queensland could be depended upon to do her share. Already two officers had been sent overseas to investigate tobacco culture in its various phases, and the data collected as a result of these expeditions had been made available to the C.S.I.R. Other officers had devoted their attention to the more or less domestic side of tobacco production.

The Pooling of Brains.

WHILE there were many problems which had to be tackled by research workers in tobacco, there were certain items of particular importance which would have the first attention, Mr. Bulcock added. One difficulty which had to be contended with in Australia was the shortage of trained man power, and in using that man power it not infrequently happened that, through overlapping and duplication of services, a certain amount of effort was dissipated. The fact that it was possible for members of all the research organisations in Australia to meet and discuss relevant matters, with the idea of rendering mutual assistance, indicated that it might be possible to pool our big tobacco problems and have them distributed among the different bodies in a way that would enable one State to devote itself to a particular problem, another State to another, and so on, as was done in the case of the dairying industry. This would be a big step towards obviating the dissipation of scientific effort.

In the field of legislation Mr. Bulcock suggested to the Conference that a suitable resolution should be framed which would have this matter included on the agenda for the next meeting of the Australian Agricultural Council with the idea of bringing about some degree of uniformity of enactments giving a greater measure of protection to the industry as a whole. Legislation was especially necessary to cope with the problem of seed imports. This matter was of pressing importance, and he rather favoured the idea of all importations being handled by some central body such as the Council of Scientific and Industrial Research.

So far as Queensland was concerned, there was nothing insular about the attitude adopted to agricultural research, and no work was undertaken purely for the benefit of our own State. We were ever willing to make available the data which were being accumulated in the various fields of research. All other States were equally anxious to exchange reports and opinions and in this way a fair measure of co-ordination was attained.

An All-Australian Industry.

REVERTING to the matter of prejudice against Australian tobacco, Mr. Bulcock pointed out that, although most smokers were ignorant of the fact, a very large quantity of Australian leaf was being included in a goodly number of the popular brands on the market at the present time. He again stressed the necessity for the thorough exploitation of our soil types so that a wide range of leaf type would be produced, enabling the manufacturers to put out quality blends. This matter presented constant scope for effort, and the future of the industry depended upon what results accrued. We should not be content to have merely a percentage of our home grown leaf on the market, but should strain every effort to make tobacco an all-Australian industry. Only co-operation among all the States would achieve this end.

Special tribute was paid to the work of the C.S.I.R. by Mr. Bulcock, who stated that the work of this body was proving of invaluable assistance to the development of agriculture in Australia. By reason of the fact that their efforts were in no way spectacular much that they did went unrecognised and unlauded by the people. The evolving of the vapour treatment for the control of blue mould in seed beds was an especially meritorious performance.

Mr. Bulcock extended to delegates a hearty welcome to Queensland. He felt sure that the visitors would share his opinion that Queensland was a very progressive State, which would probably one day be the most important tobacco producer in the Commonwealth. He assured them that any matter touching Queensland which they cared to refer to him as a result of their discussions would receive his most careful consideration.

The Meat Industry—A Correction.

IN a paragraph on the meat industry on this page of the July issue, the Premier, Hon. W. Forgan Smith, was quoted as saying in the course of a Press interview at Fremantle that "one thing was quite certain: there is now a future for the frozen meat industry...." In the original message from which the quotation was made the word "frozen" was substituted in error for the word "chilled." The actual words used by the Premier were:—"One thing is quite certain; there is now a future for the *chilled* meat industry, and we must improve the quality. We must produce a better type."

Agricultural News Service to the Country Press.

MATTERS agricultural develop so quickly at times that it has been deemed necessary, in order to give a last-minute service, to issue a weekly Bulletin to the Country Press.

It is the aim of the Department to give an efficient service, and consequently matters of immediate and outstanding importance will be dealt with through the columns of the "Weekly News Bulletin." It is not intended that the Bulletin shall supersede the "Agricultural Journal," but rather that it shall be complementary to it.

Highly-trained agricultural scientists, who can speak with definite authority upon the questions with which they deal, will be regular contributors to its columns, and I hope that our new venture will prove to be another link in the chain of co-operation between the Producer and the Department of Agriculture and Stock.

The task of preparing a weekly Bulletin, without addition to our staff, is a big one, but it is felt that the value of a weekly agricultural information service will fully justify our efforts.

Newspaper editors are cordially invited to reprint the information contained in the "Weekly News Bulletin," and their co-operation in this practical form of agricultural extension work will be greatly appreciated.

Frank. W. Bulcock

Minister for Agriculture and Stock.

The Tobacco-growing Industry in the United States of America.

L. F. MANDELSON, B.Sc.Agr., Plant Pathologist.

[*Continued from July*, 1936.]

Cat 11.2

TOBACCO DISEASES.

ALTHOUGH blue mould is not at present a very serious factor in tobacco production in the United States, several other diseases, some of which have not as yet become established in Australia, are causing increasing concern.

The disease situation is summarised in the United States "Year Book of Agriculture, 1934," as follows:—

"Omitting mention of relatively minor troubles our growers at present must contend with no less than four serious root diseases—root knot (*Heterodera radicicola*), black root rot (*Thielavia basicola*), brown root rot, and Granville wilt (*Bacterium solanacearum*). There are also five destructive leaf diseases—mildew or blue mould (*Peronospora* sp.), blackfire (*B. angulatum*), wildfire (*B. tabacum*), drought spot, and mosaic."

Some of these troubles are most difficult to control, and there is evidence that the areas involved are gradually increasing. Consequently, it is at present realised that diseases as a factor limiting tobacco production are yearly becoming more important, and the problem of their control is receiving considerable attention. As evidence of this it may be noted that special conferences of tobacco pathologists from various parts of the United States were held in August, 1934, and in August, 1935, for the purpose of discussing and co-ordinating disease control work and stimulating further research. Subsequently, in November, 1935, a permanent organisation known as the "Tobacco Disease Council" was formed with the object of co-ordinating the work of the Experiment Stations, Federal Government, and other research agencies.

Furthermore, the tobacco pathological staff of the United States Department of Agriculture has been considerably strengthened recently, and problems of disease control are being vigorously investigated. Special efforts are being made to develop resistant strains of tobacco for one or more of the major diseases with suitable characteristics for specific districts. The soil-borne diseases are receiving particular attention. The Chief of the Division of Tobacco and Plant Physiology has expressed the opinion that "the importance of the disease problems in tobacco production can hardly be over-estimated." Tobacco pathology in the United States is possibly receiving more attention than any other field of tobacco research at the present time.

At the Interstate Tobacco Research Conference held in August, 1935, the pathologists present expressed the opinion that "one of the most important fundamental problems relating to agriculture upon which present scientific information is entirely inadequate deals with the ecological relations affecting soil-borne plant parasites." In future probably more attention will be given to soil compositions and characteristics, reaction, flora, temperature, prior crops, &c., as they influence soil pathogens, than has been the case in the past.



Plate 47.

Blue Mould Investigations.—Glasshouses and tobacco seed-beds used for blue mould investigations at the Virginia Polytechnic Institute.

Blue Mould.

Blue mould (*Peronospora tabacina*) first made its appearance in the United States in 1921, when it was observed in Florida and Southern Georgia. The authorities, realising the importance of blue mould in Australia, built the North Florida Experiment Station in 1922 for the specific purpose of studying the disease. Blue mould, however, did not reappear until 1931. The following year it was apparently the major factor in reducing the area under crop by some 300,000 acres. Since then, although it has caused considerable anxiety and has been apt to delay the setting-out of plants, it has not been responsible for any serious damage. At the present time growers plant extra seed-bed areas, and usually succeed in setting out the area anticipated.



Plate 48.

Spraying Experiments.—Experimental blocks in a large seed-bed in North Carolina being sprayed with various fungicides for the control of blue mould. Note the size of the cheese-cloth cover which has been partly removed.



Plate 49.

Spraying Experiments.—Seed-beds at the Coastal Plain Experiment Station being sprayed with fungicides in blue mould control experiments.

Blue mould generally makes its appearance in seed-beds when plants are almost large enough to set out and when mild weather conditions are being experienced. The seedlings are rarely killed. Generally most of the leaves may be destroyed, but the growing point survives and in due course the plants completely recover. Growers tend to encourage this recovery by the systematic application of nitrate of soda, together with ample sunlight. Under American conditions fungicides have not given satisfactory results. They have the effect of delaying the advent of the disease, but eventually the plants become affected and lose their leaves. Consequently, sprayed plants develop the disease later and recover later than those which receive no treatment, and under such conditions spraying is obviously detrimental.



Plate 50.

Power Spraying.—A large-scale spraying experiment in Maryland being carried out by the United States Department of Agriculture, using a high-pressure power sprayer for applying fungicides to control blue mould and bacterial diseases.

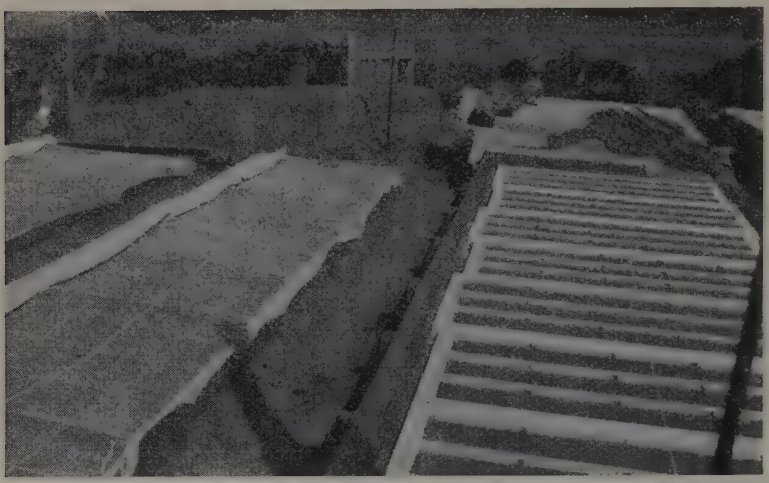


Plate 51.

Heated Tobacco Seed-beds.—Experimental seed-beds for the control of blue mould at the Coastal Plain Experiment Station, Georgia. The air above the bed on the left was heated with a charcoal fire. The soil of the other two was heated with hot air from wood fires. Materials for seed-bed covers were also being investigated.

The United States Department of Agriculture and several research institutions (Plates 47, 48, 49, 50) are, nevertheless, investigating the possibilities of numerous fungicides as well as other control methods, since it is realised that effective methods for the control of the disease would be very desirable should a repetition of favourable conditions, such as those of 1932, occur. Copper sprays, such as cuprous oxide with cotton seed oil emulsion and colloidal copper with soap appear to be as effective as any. Very satisfactory results have been obtained by

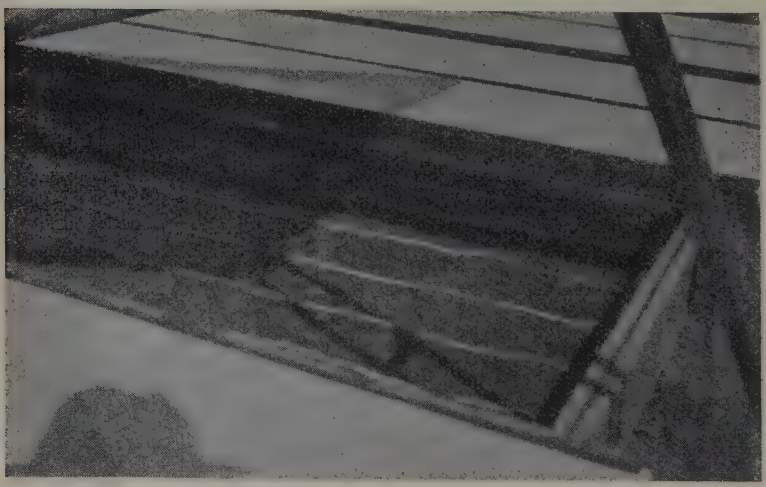


Plate 52.

Electrically Heated Seed-beds.—A seed-bed at the Coastal Plain Experiment Station for the control of blue mould, where heat was supplied by a lead-covered electric cable running over the surface of the soil.

growing seedlings in beds which are artificially heated so as to maintain a minimum temperature about 70 deg. Fahr. Various methods of heating the beds and various sources of heat, such as wood, oil, and electricity, have been investigated. (Plates 51 and 52.) It would seem, however, that such methods are at present too costly to warrant adoption. All commercial varieties appear to be equally susceptible to the disease. Numerous exotic types, however, have been introduced and tested for resistance. Of these an Argentine variety appears to have the greatest degree of resistance, but it is by no means totally resistant, and does not have the characteristics of a flue-cured tobacco.

At the present time the official recommendations involve the following measures:—The use of new sites for seed-beds or sterilizing old ones, the selection of a warm, sunny situation for the bed and allowing ample sunlight and air to the plants, destroying hold-over plants from the previous season, early sowing of seed, sowing reserve bed space, avoiding



Plate 53.

Investigating Blue Mould Dispersal.—An investigator in North Carolina removing a glycerine-covered plate used for catching fungus spores. A metal vane which keeps the plate facing the direction of the prevailing wind may be seen to his left. Self-recording meteorological instruments for air and soil data are housed in the wooden boxes in the foreground.

overcrowding of beds, only working in beds when plants are dry, avoiding the dissemination of spores on clothing by moving from infested to non-infested beds, the use of nitrate of soda to increase the rate of growth of diseased plants, if necessary, and avoiding the setting-out of diseased plants until they have recovered.

At the Duke University fundamental information on the epiphytology of blue mould is being collected by means of careful seed-bed surveys, the use of self-recording meteorological instruments (Plate 53), and the periodic examination of spore-traps in the vicinity of seed-beds. The data so far indicates that initial infection develops in seed-beds which have been used during the previous season. Consequently, Dr. F. Wolf has expressed the opinion that blue mould could be eliminated in the United States if new beds were used entirely throughout the tobacco belt. In this connection it should be noted that the severity of

the winter in America tends to effectively eradicate tobacco plants between seasons, and even if the above procedure were successful in the United States it would not necessarily be so under Australian conditions. Work of this nature which accurately correlates disease outbreaks with prevailing weather and soil temperatures should be most helpful as a foundation for further research. Generalising the work at this institution on the occurrence of blue mould it would seem that an outbreak of the disease might be expected when a period of heavy sporulation is followed by a few days of windy weather with low relative

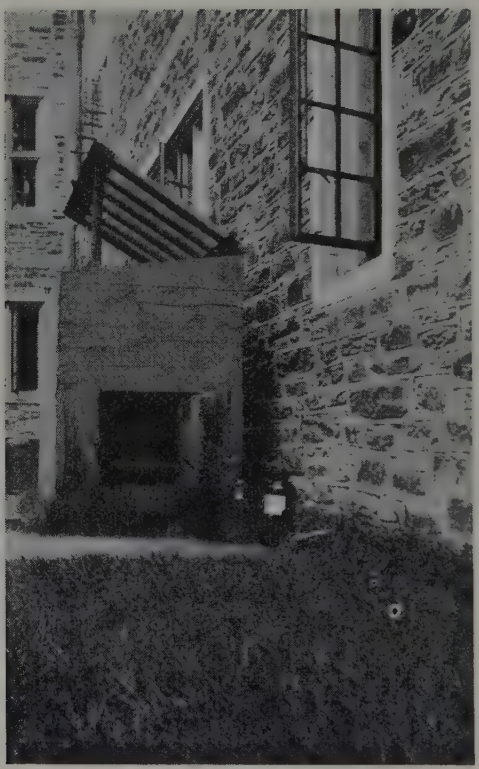


Plate 54.

A Constant Temperature and Humidity Cabinet.—This apparatus is in use at the Duke University, North Carolina, for keeping tobacco plants throughout the year under optimum conditions for blue mould studies.

humidity. An outbreak may occur when night temperatures vary between 45 deg. Fahr. and 60 deg. Fahr., and day temperatures do not exceed 84 deg. Fahr. These conditions are usually associated with showery weather.

For the purpose of studying the disease throughout the year special constant temperature and humidity cabinets are used at several institutions for growing plants affected with blue mould. (Plate 54.) Studies on the causal organism indicate that spores are not produced at temperatures above about 70 deg. Fahr., but infection may take place up to 86 deg. Fahr.

In the United States blue mould has so far been a seed-bed trouble entirely, and damage in the field is practically unknown. This may possibly be correlated with the fact that during the summer months, when the crop is growing, the minima temperatures recorded are consistently high.

Blue mould has been reported from Florida, Georgia, South Carolina, North Carolina, Virginia, Southern Maryland, and Tennessee. Although it has been present in Tennessee since 1933 it has not caused as much damage in the Burley crop of that State as might be anticipated. Under Australian conditions Burley is most susceptible to blue mould. However, although seed-beds of Burley tobacco in Tennessee are possibly more seriously damaged than is flue-cured tobacco in other States, the disease is by no means as severe as it is in Australia, and tobacco is not affected in the field.

Hence, with the exception of 1932, blue mould has not been a serious trouble in the United States, but it is considered a potential menace to the industry, and every effort is being made to evolve successful control measures.

Root Knot.

The root knot nematode (*Heterodera marioni*) is most destructive at relatively high temperatures in light soils, and consequently is a serious factor in the production of flue-cured and cigar tobaccos in the Southern States. A special resolution of the recently formed "Tobacco Disease Council" indicated "that nematodes constitute the biggest plant problem in the South, and urges that more intensive study of nematode problems be conducted, and that it be carried out on a co-ordinated basis as far as possible." As indicative of the importance of the nematode problem in general, the United States Department of Agriculture maintains a special Division of Nematology, with a staff of approximately twenty research workers and two field stations. Investigations are also being carried out by the Division of Tobacco and Plant Physiology, as well as by various State Agricultural Experiment Stations.

Root knot is not a problem on the heavier tobacco soils or in the more northern States where seasonal conditions are cooler and soils are heavier. It does, however, frequently cause serious losses in the South, although, apparently, in 1935 the weather experienced was not conducive to severe infestation, and the damage observed was not as extensive as usual. An additional factor involved in the control of nematodes in the cigar wrapper district of Florida is the high cost of the artificial shade tents under which this class of tobacco is grown, and which, consequently, makes control by rotations very expensive. Frequently commercial "shades" can only be successfully used for tobacco cultivation for two years owing to root knot. Nevertheless, it has been demonstrated at the North Florida Experiment Station that it is possible to grow tobacco on the same land continuously for thirteen years with success. The method adopted there is to maintain a thoroughly bare fallow for the ten months of the year that tobacco is not in the field. The time of planting is an important factor in regard to the degree of nematode infestation. When plants are set out late in the season high temperatures stimulate nematode activity, and consequently such plants are more seriously affected than earlier plantings. Nematode damage is most serious if plants are infested when they are young. Growers are advised to encourage the rapid growth of the crop in order to mitigate nematode injury.

The most intensive field experiments observed, consisting of rotational and cultural investigations, are being carried out at the Coastal Plain Experiment Station, in Georgia. (Plate 55.) Some of these experiments were commenced in 1925. So far the most effective control measure consists of growing tobacco after two years of bare fallow. A promising rotation, both from the viewpoint of root knot control and tobacco quality, consists of growing peanuts the first season, oats and weeds the second, and tobacco in the third year. Where runner peanuts are used the leaf of the subsequent tobacco crop may be coarse, and consequently the amount of nitrogen in the tobacco fertilizer should be reduced. Spanish or bunch type peanuts, which are usually dug, are considered preferable, as they do not have the same tendency to result in rough leaf. The success of a weed rotation depends on the nature of the weeds grown, since some are susceptible to nematodes. In Florida a weed known as Florida pursley (*Richardia scabra*) is prevalent, and is desirable. In other States the most successful weeds in rotations are



Plate 55.

Tobacco Rotational Experiments.—A general view of some of the rotation plots at the Coastal Plain Experiment Station in Georgia.

horseweed (*Erigeron canadensis*) and rag-weed (*Ambrosia artemisiifolia*). Where soils are not heavily infested a two-year rotation may be practised with some success. Promising crops for this purpose over the past three years have been peanuts, *Crotalaria retusa*, Laredo soybeans, or a combination of oats followed by a late crop of Crotalaria. Velvet beans were not as effective in rotations as those crops already discussed.

Corn, Brabham cowpeas, and cotton have not been found consistently successful. Serious nematode damage may result when tobacco is grown after sweet potatoes, Clay cowpeas or field peas, or after tobacco.

The effectiveness of rotations depends on the specialisation of nematodes for feeding on certain crops. As a control method rotation is not always satisfactory, possibly due to susceptible weeds growing with the resistant crops, and so carrying the nematodes over, or, possibly, nematodes may in time adapt themselves to resistant hosts. It is known that nematodes have not been eradicated on a soil even after it had been cropped with peanuts for ten years. However, at the present

time rotations offer the most practical method of control, and the use of resistant crops adapted to local conditions is recommended. In practice crops such as velvet beans, corn, and Brabham cowpeas frequently give reasonable control as rotation crops, although, apparently, they are not immune. The sterilisation of seed-bed soil, the early setting-out of plants in the field, the encouragement of vigorous growth by appropriate cultural methods, are all found to be helpful in the control of root knot. It is recommended, furthermore, to avoid badly infested soil for tobacco culture.



Plate 56.

Black Shank in Florida.—A plant of cigar wrapper tobacco severely wilted as a result of black shank infection. Prior to the development of resistant varieties black shank threatened the shade tobacco industry in Florida with extinction.

With the possible exception of Faucett's Special, which is said to be moderately resistant, all commercial varieties are quite susceptible to root knot. A recent foreign introduction known as White Honduras also has some degree of resistance.

Black Shank.

Black shank (*Phytophthora parasitica* var. *nicotianæ*) is another soil-borne disease which is causing increasing concern in the United States. It was first observed in Southern Georgia, and quickly spread to Florida, where at one time it threatened the valuable cigar wrapper industry with extinction. (Plate 56.) It was investigated from 1922 to

1929 by Tisdale, who, as a result of his brilliant plant-breeding work, developed resistant strains of cigar varieties of satisfactory commercial quality. These varieties are not immune, although some are highly resistant. Nevertheless, long rotations, omitting tobacco for five or six years, are at times practised in conjunction with them for the control of the disease. Black shank is still being investigated in Florida with the object of developing more satisfactory strains, to ascertain the nature of inheritance of resistance, and also to obtain fundamental knowledge on the pathogen and environmental conditions associated with the development of the disease.



Plate 57.

Plant-breeding for Disease Resistance.—Resistant and susceptible strains of tobacco growing on black shank infested soil in North Carolina.

In 1930 the alarming discovery was made that this destructive organism was present in the Old Belt of North Carolina, near Winston Salem, where it had possibly been present for some time and confused with Granville wilt. In 1935 it was found that its geographic range had been extended considerably, and was established in most of the Old Belt, where it was causing serious damage. It is not known to what extent it may eventually spread into the New Belt of that State.

Fortunately, tobacco is apparently the only host plant of this disease, but it can survive more or less indefinitely in the soil, and land has been known to remain infested for at least eight years. Long rotations with crops other than tobacco are being practised in the flue-cured areas at present. All commercial flue-cured varieties are quite susceptible to the disease, but there is hope, as a result of recent plant-breeding work in North Carolina (Plate 57), that hybrids may shortly be produced which may successfully be used for the control of black shank.

This disease is of particular interest, since one isolated case of its occurrence has already been reported from Queensland.

Granville Wilt.

Granville wilt is a serious soil-borne disease caused by *Bacterium solanacearum*. It was first recorded from Creedmore, in North Carolina, several years ago. Apparently it is spreading rapidly, and is one of the most menacing diseases in the flue-cured tobacco areas of that State at present. Control is extremely difficult, since many weeds are host plants and their presence, consequently, tends to nullify rotations with resistant crops. The use of resistant varieties is probably the most hopeful line of attack (Plate 58), but the development of such varieties with acceptable quality is not yet in sight.



Plate 58.

Granville Wilt Resistance Studies.—A plant pathologist in North Carolina hybridising tobacco with the object of producing a resistant variety with acceptable quality. Note the wilted plants in the foreground.

Fundamental knowledge on many aspects of the disease is rather scanty, but research work on this subject is now being vigorously undertaken. During 1935 an extensive experimental area, with a comprehensive series of experiments to investigate host range, varietal resistance, and control by soil treatments, was established in North Carolina. One hundred and twenty-five selections of tobacco were tested for resistance at Washington, D.C., and Creedmore. It was found that all domestic varieties were highly susceptible. Some introductions were moderately resistant, the most promising being a non-flue-curing type from Java. Thirty-five species of cultivated plants and weeds were tested for susceptibility (Plate 59), and valuable information on the host range of the pathogen was thus obtained. Chemical treatments of the soil were not promising, and in many cases were detrimental to plant growth. Laboratory and greenhouse investigations are also in progress, but such work is difficult owing to the fact that the causal organism very rapidly loses its viability in culture.



Plate 59.

HOST RANGE INVESTIGATION.—An experimental plot in North Carolina to investigate the host range of Granville wilt. In the foreground may be seen rows of tomatoes and peppers.

It would seem that by practising a five-year rotation with resistant crops severe infection can be reduced to about 10 per cent. infection. There is, however, generally some infection which is apparently carried over by weeds. Once the degree of infection has been reduced in this fashion it is safe to practise a three-year rotation. Corn, cotton, sweet potatoes, and velvet beans are frequently used in such rotations with tobacco. Success with rotations depends largely on the thoroughness with which weeds are eliminated in cultivation.

Granville wilt occurs in South Carolina and Virginia, as well as in North Carolina. It is most destructive on light soil types (Plate 60), such as are most desirable for the production of flue-cured tobacco. In some cases it is found in widely separated and relatively small areas. The fact that it is apparently gradually spreading and is so difficult to control is being viewed with some alarm.



Plate 60.

GRANVILLE WILT.—A field of tobacco growing on a light soil type in North Carolina severely affected with Granville wilt. Legumes have been planted (to make use of the fertilizer) where the tobacco has been killed.

Black Root Rot.

Unlike other soil-borne diseases already discussed, black root rot (*Thielavia basicola*) does not cause a spectacular collapse of the crop in the field, but may, under favourable conditions, appreciably reduce yields. It is one of the most widely distributed tobacco diseases in America. A considerable amount of plant-breeding and investigations along other lines have been carried out for several years past in the United States in connection with it, and recently this work has been greatly stimulated. In the past James Johnson and also Valleau developed satisfactory strains of resistant Burley and cigar tobacco. In the flue-cured tobacco belt Bullock is now obtaining promising results with three selections of flue-cured tobacco (Plate 61), one of which (No. 400) is being grown commercially. Similar investigations are also being carried out with various classes of tobacco by State Agricultural Experiment Stations and the United States Department of Agriculture in Tennessee, Virginia, Maryland, and New England.



Plate 61.

Black Root Rot Resistance.—A black root rot resistant selection (No. 400) shown on the right. Note contrast in height with control row on left, although black root rot was not severe in North Carolina during the 1935 season.

Black root rot is greatly influenced by environmental conditions, such as temperature and soil acidity. It is particularly severe at low temperatures, and consequently may be a serious trouble in the more northern States. Nevertheless, in seasons favourable for its development it may also be an important factor in tobacco production in the southern flue-cured tobacco districts, especially during the early part of the season. It was not, however, a serious factor during 1935 in the flue-cured tobacco districts, but did cause damage in the Burley-growing States. The development of black root rot is limited by soil reaction, and alkaline soils are conducive to infection. Some years ago liming was recommended as a cultural practice for tobacco soils, but owing to this disease it is now realised that more or less permanent damage may be caused by so doing, and consequently it is no longer recommended. Acid soils are found most satisfactory for tobacco culture, and a reaction of pH 5·4 is considered to be on the danger line. Quite recently preliminary investigations indicated that nutrition may also influence the degree of black root rot infection.

Black root rot has caused considerable concern in the past in many States, but now the problem of control has been more or less solved by the use of resistant varieties and the better management of the soil. Nevertheless, in some sections, particularly where Burley tobacco has been grown for a number of years, the soil is so heavily infested that it is practically impossible to grow ordinary varieties of tobacco (Plate 62). Black root rot also has had a tendency to become more prevalent in recent years in some of the dark tobacco and flue-cured tobacco areas.

Mosaic.

Mosaic, which is caused by plant viruses, has been more intensively investigated than any other tobacco disease, and an immense bibliography has been built up on the subject. Numerous research workers are now engaged on this and other virus problems in the United States.



Plate 62.

Burley Tobacco affected with Black Root Rot.—Burley tobacco growing on black root rot infested soil in Tennessee. Note extreme stunting and wilting in susceptible control row.

Some interesting work is at present being carried out at several centres on the mode of transmission of these diseases, on resistance thereto, and on the nature of the viruses involved, as well as their rate of movement in plant tissue.

Mosaic is very generally distributed throughout the various tobacco-growing areas, and careful studies have indicated that it may cause considerable losses. In some States, such as Virginia, it is claimed to be of more importance than any other disease. Its severity apparently varies from year to year, and is possibly associated with the weather conditions which are experienced between seasons.

Investigations in North Carolina have shown that it is not carried over to any great extent in the soil, particularly when stalks and roots are removed from the land. Lehman estimates that from twenty-three plots of contaminated soil only an average of 1·5 per cent. of the plants were infected from the soil during a four-year period of experiments. He states that "apparently a large part of the virus of mosaic added to the soil by a crop of diseased tobacco is inactivated by physical, chemical,

or biotic processes going on in the soil during the fall, winter, and spring months." Nevertheless, although only a small number of plants may be infected in this manner, it is realised that the disease may be rapidly carried through the crop subsequently unless precautions are taken. The amount of initial infection from contaminated soil has been correlated with the time and method of disposing of diseased plants. Substantially similar results are being obtained in Kentucky. The technique used by Valleau in that State was rather ingenious. A specific strain of yellow mosaic, the symptoms of which can be readily distinguished from those of other mosaics, was used as soil inoculum. Consequently, in the event of plants becoming accidentally infected, they could be easily observed and discarded. It is claimed by Johnson, however, that contaminated soil is quite an important factor in the transmission of mosaic in Wisconsin. This may possibly be due to differences in climate, since Wisconsin is much further north than most of the tobacco areas.

Mosaic is probably not transmitted to any great extent by insects. The field occurrence of the disease, where affected plants are usually found in rows rather than in broad patches, suggests that infection is carried mechanically down the rows rather than disseminated widely by insects. A few years ago Miss Hoggan demonstrated that aphids did not transmit the tobacco mosaic virus from one tobacco plant to another, although they may transmit the same virus from infected tomatoes to tobacco.

Investigations in Kentucky and North Carolina indicate that the mosaic virus may survive in manufactured tobacco, and that the disease is frequently introduced into tobacco beds through the habit of chewing or handling such tobacco. Subsequent spread of the disease is the result of weeding and handling plants in the seed-bed, and by cultivation and other field operations after the crop has been set out. Wolf maintains that "the virus is introduced by the grower and that manufactured forms of tobacco constitute the most probable source."

It is fairly generally agreed that mosaic as it occurs in the field may be caused by any of several viruses. Kunkel and his co-workers have separated some fifty such viruses. At present Valleau is developing an interesting theory that certain virus diseases may have two phases of symptoms, which may be described as "invasive" and "occupative." He considers that mosaic mottling may occur as the "occupative" phase of some twenty-five different virus diseases. "Burning" or "scalding" is usually regarded as an aspect of ordinary green tobacco mosaic, brought about by the weakening of tissue invaded by that virus. Valleau, however, is of the opinion that it is the "invasive" phase of a specific virus which subsequently develops mottling or mosaic symptoms as its "occupative" phase.

The most intensive research in the United States on virus diseases is being carried out at the Rockefeller Institute for Medical Research. In recent years the scope of this institution was broadened to embrace plant problems, with the object of establishing closer co-operation between medical and plant pathologists. Investigations at present under way involve the nature of the virus, the separation of mosaic viruses, and immunology studies. In 1935, Stanley, at that institution, made the important preliminary announcement that he had isolated a crystalline protein possessing the properties of tobacco mosaic virus. He regards this virus as being an autocatalytic protein which it is assumed requires

the presence of living cells for multiplication. Should the virus ultimately be definitely proved to be a crystalline protein, it will profoundly affect disease investigations in general. This investigation is causing considerable interest amongst plant pathologists in the United States. White has developed a technique for the continuous culture of plant root tips in artificial media. It has a practical application in the storage of plant viruses which cannot be kept *in vitro*, and several virus cultures are now being maintained by means of root tip cultures. Interesting investigations are also under way on the seriological method of grouping virus diseases.



Plate 63.

Mosaic-resistant Tobacco.—A row of Ambalema tobacco, which is practically immune to mosaic.

Until recently all types of tobacco were found to be susceptible to mosaic. The only exception is a Porto Rican variety known as Ambalema (Plate 63), which is practically immune. This discovery had stimulated research into the possibility of breeding for mosaic resistance in various classes of tobacco. The United States Department of Agriculture is now crossing Ambalema with flue-cured, Burley, Maryland, and cigar types, and the progeny are being propagated at appropriate centres.

Recommendations for the control of mosaic involve clean or sterilized soil in the seed-bed, the avoidance of the careless use of manufactured tobacco, the elimination of solanaceous weeds, some of which may carry the virus without showing mosaic symptoms, care in handling seedlings

and in cultural operations, and the elimination of diseased plants at the first cultivation. Where the disease is severe a rotation for a year or two with corn is desirable.

Ringspot.

Ringspot is another virus disease which is being investigated to some extent, particularly in Kentucky and Virginia. An important aspect of the disease, and one in which it differs from mosaic, is that it is seed-borne. It was noted mostly in the Burley and in some cigar tobacco districts. In Pennsylvania it was quite severe in 1935, and was more general than mosaic. Two distinct types of ringspot, yellow and green, have been isolated. The variety Ambalema is not resistant to this virus disease.

Bacterial Leaf Spots.

The bacterial leaf spots, wildfire (*Bacterium tabacum*) and angular leaf spot (*B. angulatum*) have been reported from most of the tobacco-growing areas. They were once prevalent in the Southern States, but apparently are not very common there now. These diseases were observed causing extensive damage only in Tennessee, Maryland, and Pennsylvania.

Angular leaf spot and blackfire have been used as synonymous terms. Investigations in Kentucky, however indicate that angular leaf spot has in the past been confused with a physiological trouble, probably caused by unsuitable soil conditions. The name blackfire is suggested for this non-bacterial disease.

Valleau's work suggests that these diseases are not actually carried on cleaned seed, but may be on seed trash, and that angular leaf spot in the seed-bed may be readily controlled with Bordeaux Mixture. Clayton has shown that these pathogenic bacteria are most apt to cause infection through water-soaked tissue, and has developed a technique for artificial inoculation by which water suspensions of the bacteria are sprayed on to the plants with pressure. As was actually observed in Maryland, these diseases very rapidly spread with driving rain, and the above inoculation method tends to reproduce such conditions.

Wildfire, which is more destructive than blackfire, is the only one of these diseases in Pennsylvania. It has been established there since 1919, and is probably more general in that state than elsewhere. Beach is engaged in investigating methods for the control of the disease. This work involves host range studies, rotations, means of over-wintering, effect of rain, chemical treatment of the soil, and seed-bed spraying.

Miscellaneous Diseases.

Southern root and stem rot (*Sclerotium rolfsii*) was observed to some extent in the southern tobacco areas, and it was stated that it has become more prevalent there during the past three or four years. Previously it has been more of a trouble with ornamentals, but apparently now it is becoming increasingly prevalent on field crops. It will probably be the subject of future investigations. At present corn, cotton, and small grains are recommended as rotation crops to be used for its control.

"Frenching" is the oldest known disease of tobacco, and although it has been investigated for many years its cause is not yet understood. It is frequently of considerable importance on the heavy soils of the

Burley-growing areas (Plate 64), but is of minor significance on the light soils of the flue-cured belt. Recent investigations by Shear in Virginia suggest that "frenching" is the result of some toxic substance or organism in the soil.



Plate 64.

FRENCHING.—Burley tobacco affected with an obscure disease known as "frenching."

Drought spot is also being investigated, by Shear, and apparently he is the only worker on this subject. Results so far from nutritional investigations indicate that drought damage is mitigated when a balance between the nitrogen and potash elements in the soil is maintained. Excess nitrogen increases susceptibility to leaf breakdown and excess potash increases resistance. The presence of chlorine also tends to lessen drought injury. Low topping on the other hand renders the plants more susceptible to damage.

Fusarium wilt was observed to some extent on Burley and Maryland tobacco. It has seldom been recorded from the flue-cured tobacco areas. However, in 1935 severe infection, up to 100 per cent. (Plate 65) was observed in a few fields in North Carolina. It may eventually develop into a major problem in that section.

In some sections of eastern North Carolina "drowning" as a result of heavy rains late in the season also caused some damage (Plate 66).



Plate 65.

Fusarium Wilt.—Flue-cured tobacco in North Carolina severely affected with Fusarium wilt.

General Observations.

The most striking development in tobacco pathology at present is an attempt to develop resistant varieties for most of the major diseases. The nature of many of the diseases involved makes this mode of attack the most logical for practical control. However, it is largely dependent on imported varieties of no commercial value as parents in breeding work, and it will consequently be most difficult to produce strains which will have resistance and yet satisfactory quality. The latter complicates the problem considerably, since there is no physical or chemical method



Plate 66.

"Drowned" Tobacco.—Illustrating the disastrous effect of heavy rain on tobacco late in the season in North Carolina.

available of quickly determining the quality or value of tobacco. Research of this nature will probably take many years of effort before tobacco resistant to disease and also with satisfactory smoking quality is developed. It is fully realised in certain quarters that the introduction of new resistant varieties of low quality would do more harm than good unless absolutely necessary for disease control. The influence of nutrition as a factor in disease resistance is also receiving increasing attention in the United States. It is being applied to some extent in the investigation of drought spot, blue mould, and black root rot.

The alteration of environment, in an attempt to escape infection, as exemplified by the use of heated seed-beds in blue mould control, is a new development in tobacco pathology. It is doubtful whether this method in its present form would be generally adopted if the necessity arose, partly because of the expense involved and also the constant care necessary for its successful operation.



Plate 67.
Dusting Tobacco.—Dusting flue-cured tobacco by means of sacks.

Marked progress is also to be noted in the field of virus disease investigations. The intensive study of particular aspects of these diseases by specialists, as at the Rockefeller Institute for Medical Research, should result in valuable fundamental knowledge.

TOBACCO PESTS.

The principal insects affecting tobacco crops in the United States are hornworms (*Phlegethontius quinquemaculata* and *P. sexta*), flea beetle (*Epitrix parvula*), budworm (*Heliothis virescens*), thrips (*Thrips tabaci*) and wireworms. Of these, hornworms are the most serious problem.

Hornworms and Arsenical Insecticides.

The general practice is to use lead arsenate for the control of hornworms in the flue-cured tobacco areas. It is applied in numerous ways as a spray or dust, with hessian sacks (Plate 67), and with sprayers and dusters of various kinds (Plate 68), and hand picking is also employed. Applications of lead arsenate are made at about weekly intervals wherever it is necessary to control a generation of worms.

Frequently, a variable amount of Paris green is added to the lead arsenate, and this mixture may be greatly diluted with lime. One formula consists of 50 lb. of lime, to which is added 2 lb. of a mixture consisting of 4 or 5 lb. of lead arsenate and 1 lb. of Paris green; this is applied at the rate of 150 lb. per acre. In this case quite a white coating of the leaves may be readily observed. There are, however, numerous formulæ used. An application of 4 to 6 lb. per acre of lead arsenate alone is frequently employed. Dusting is considered preferable to spraying, and the practice of making heavy dustings with materials excessively diluted with lime is not favoured by entomologists. Successful control depends to a large extent on the efficiency of the duster employed. Autumn ploughing has been found to be very effective in reducing the number of overwintering hornworm pupæ, and is helpful as an additional control measure. Some progress has been made in experiments whereby poison baits, containing tartar emetic, with amyl salicylate as an attractant, have been used for trapping hornworm moths.



Plate 68.

Spraying a Field of Tobacco.—This rather novel spray outfit consists of a barrel of spray material mounted in a sledge drawn by a mule. A negro on the sledge works the pump, and the insecticide is applied from a hose on either side.

The United States Department of Agriculture recognises the possibilities of poisoning to the consumer by the use of lead arsenate applied late in the season, and does not recommend its use then. In this connection it should be noted that chewing and snuff tobaccos are largely used in the United States, and consequently the presence of toxic substances on such tobaccos is more apt to prove harmful than on flue-cured tobacco. At present, for flue-cured tobacco, Paris green at the rate of 4 lb. to 6 lb. per acre, depending on the size of the plants, is officially recommended. The use of Paris green does not eliminate the arsenical residue factor, but it does obviate the more subtle lead poisoning. It is not, however, entirely satisfactory, since severe burning of the leaves frequently results from its use. Entomological research is chiefly concerned at the present time in finding a suitable substitute for lead arsenate which will not be toxic to human beings. Apparently hornworms are not susceptible to insecticides containing rotenone and pyrethrum.

In Tennessee, Marcovitch first drew attention to the use of cryolite (sodium aluminium fluoride) some ten years ago as an insecticide. He is now investigating a new product known as "Artificial Cryolite," which has good physical properties and which he found to possess a high degree of efficiency. He considers it a suitable substitute for lead arsenate for hornworm control. The American health authorities, however, do not favour the use of fluorides on tobacco or products for human consumption. In this connection, Marcovitch is of the opinion that the arbitrary fluorine tolerance limit set is far too conservative and could safely be increased ten times. He is at present investigating the toxicity of fluorine with certain plants, and anticipates working with animals later.

There is apparently little tobacco entomological work being carried on in state institutions, although the problem of obtaining a suitable lead arsenate substitute for general purposes is being investigated in some cases. Possibly derris root is the best available substance at present.

Budworm.

Budworm is considered the second most important tobacco insect pest. A control method which appears to be quite efficient was developed at the Quincy Tobacco Insect Field Laboratory in Florida. It consists of applying a small pinch of a mixture of corn meal and lead arsenate well into the bud of the plant. The mixture consists of 1 lb. of lead arsenate and 75 lb. of corn meal. About eight applications at an estimated cost of 2 dollars 16 cents per acre is considered sufficient for control. The greater part of the injury caused by budworms is produced by the small larvæ feeding on the immature bud leaves of the tobacco. Hence an important aspect of the method is to open the bud and drop some of the mixture into it rather than sprinkling it over the plant. Corn is universally used with the bait as it is attractive to this insect. With some types of tobacco, corn is considered an expensive item, and consequently some tests are now in progress to endeavour to find an acceptable substitute for corn meal with this bait.

Miscellaneous Insects.

In practice, growers apparently do not take active measures for the control of other insect pests. However, flea beetles may cause appreciable damage, particularly with flue-cured tobacco. Investigations by the United States Department of Agriculture have indicated that flea beetles can be satisfactorily controlled by dusting barium fluosilicate on the seed-beds at the rate of ½ lb. per 100 sq. ft., and on larger plants in the field at the rate of 3 to 5lb. per acre. Derris dust mixtures, containing 1 per cent. of rotenone, with sterilized finely-ground tobacco dust as a diluent, also has given good control in the seed-bed, when applied at ½ lb. per 100 sq. ft. Further investigations are in progress with this method for control in the field. No satisfactory methods of control have yet been developed for wireworms or thrips.

Insect Pests of Stored Tobacco.

Cigarette beetle (*Lasioderma serricorne*) and tobacco moth (*Ephestia eleutella*) are important insect pests of stored tobacco, and the United States Department of Agriculture has made considerable progress in the problem of their control by fumigation. While in Virginia, the operation of fumigating the closed stores of the American

Export Company with hydrocyanic acid gas was observed. Prior to fumigation all openings are sealed with brown paper or a paste made of asbestos and calcium chloride. Cylinders containing hydrocyanic acid gas are mounted on scales (Plate 69) in order to measure the amount of gas used, and the gas is pumped into a permanent installation of pipes with which these stores are equipped. A company which specialises in this type of work fumigates tobacco stores by contract.



Plate 69.

Fumigating Tobacco Stores.—Fumigating a closed tobacco store with hydrocyanic acid gas. Note the cylinder of gas mounted on scales to measure quantity used. Electric current to actuate the pump is taken from the overhanging light fitting.

A more recent development is to partially control insect pests by refrigeration. Cool stores were inspected, at which a temperature of 63 deg. Fahr. was being maintained, for the purpose. During ageing, tobacco tends to lose its colour by seasonal "sweating." Hence this method, by obviating seasonal changes, has the advantage of preserving the bright colour of tobacco. Owing to the expense of the process, however, only the best grades are so treated.

A considerable amount of tobacco is stored in open sheds which permit free air circulation through the sides (Plate 70). In this case, it is not possible to control tobacco insects by the usual fumigation method. The problem of controlling insect infestation under these circumstances is at present under investigation.

General Observations.

The tobacco pest control situation does not appear to be so acute in America as in Australia. The budworm, although differing in species, is common to both places, and leaf-eating caterpillars in Australia are rather similar in effect to the American hornworm. However, leaf miner, which is extremely destructive in Queensland, and stem borer are not important tobacco pests in the United States. The control methods at



Plate 70.

Tobacco Storage Sheds.—It is not possible to fumigate open sheds of this type by the usual method. The illustration shows a few of the thirty sheds in this one storage area. Several similar areas are usually located in the vicinity of tobacco manufacturing towns.

present employed in the United States appear to be quite effective in regard to pests of major importance. The main difficulty, however, lies in the objectional nature, from the toxic residue viewpoint, of the materials used. In Australia these substances could not be used late in the season, and the problem of control is consequently more difficult here.

The present situation regarding the use of lead arsenate in the United States appears to be somewhat as follows. In order to grow tobacco successfully, growers are absolutely obliged to use lead arsenate at any time during the season when hornworms are developing, and this frequently occurs when the plants are reaching maturity. Due care is taken not to market leaf which is obviously coated with insecticide, and buyers do not object to the leaf as it is found in the market. Although there is no Federal or State legislation at present regulating the nature or manner of application of insecticides, health authorities do not favour the use of lead arsenate, fluorides, and other substances which might be toxic to human beings. The Department of Agriculture realises the desirability of finding acceptable substitutes and future investigations will largely be concentrated on this subject.

Entomological research generally in regard to tobacco pests in the United States appears to have been rather neglected up to the present. The United States Department of Agriculture has maintained field laboratories in Tennessee for fire-cured tobacco and in Florida for cigar tobacco, as well as in Virginia for the study of stored-tobacco insects. It has, however, in the past entirely neglected the flue-cured tobacco belt. This situation is now being remedied by a laboratory which was established as recently as July, 1935, for the study of pests of flue-cured tobacco. At the latter end of last season the officers of this station were engaged in making a detailed survey of the pest situation in the flue-cured tobacco areas.

MISCELLANEOUS RESEARCH ACTIVITIES.

One of the greatest difficulties in tobacco research consists of devising a suitable estimate of quality. The value of a new variety of tobacco or of tobacco grown in a new area cannot be estimated by casual examination, but is actually arrived at finally by the favour it finds with the smoking public. For plant improvement work, as well as for manufacturing purposes, a quick and accurate test for quality is very desirable. There have been several attempts in the past to evolve such a test. A very promising investigation along these lines is now in progress at the Duke University, where an effort is being made to develop a "Composition Index." Through the courtesy of the Chemistry Department of this institution, it was possible to peruse unpublished manuscripts there, and to discuss this important subject. By chemical analysis it aims at the comparison of various types of tobacco, as well as various crops, in regard to value, quality, maturity, and various other crop characters. It is arrived at by taking the difference of certain nitrogenous portions of an analysis (e.g., total nitrogen, soluble nitrogen, amino nitrogen, and nicotine) and the sugar-acid portions.

The Division of Tobacco and Plant Physiology of the United States Department has done and is still doing excellent work on tobacco nutrition. The tobacco plant is particularly sensitive to variations of nutrition and environment generally, and consequently is very suitable for such studies. McMurtney has published extensively on the role of the main elements nitrogen, potassium, and phosphorus in tobacco nutrition. Recent glasshouse and field work has been largely concerned with the so-called secondary elements calcium, magnesium, chlorine, and sulphur. At the Marlboro Experiment Station, where certain plots have received the same treatment for a considerable time, rare nutritional disorders, such as calcium starvation, could be readily observed.

Fundamental studies are also being made in Washington by Steinberg on general plant nutrition. He is using the fungus *Aspergillus niger* in this work, and is investigating the effect of such elements as iron, magnesium, copper, and zinc.

Some years ago it was found that Maryland Mammoth tobacco would not set seed in Maryland unless grown in winter in a glasshouse. A celebrated research by Garner proved that the length of day to which the plant was exposed was the limiting factor involved, and, consequently, yields of seed of this variety can now be successfully obtained by growing the tobacco in lower latitudes than Maryland. This work is now being extended in Washington, and some very elaborate apparatus is being used in studying the effect of length of day on the development of various plant species.

Field trials are being carried out at agricultural experiment stations in various States on various sources of plant-food materials, fertilizer formulae, rates of application, split applications of fertilizers, and rotational crops. The Bureau of Agricultural Engineering of the United States Department of Agriculture is co-operating with several State Agricultural Experiment Stations in investigating the most desirable situation in the soil for placing artificial fertilizers. This work commenced some five years ago with cotton, and is now being applied to tobacco. Such fertilizer placement trials were observed in several states. A special machine is used for applying the fertilizer and setting the plants (Plate 71). In most cases it has been found detrimental to set tobacco over a band of fertilizer. An exceptional case obtains in Maryland, probably due to the rosette habit of this tobacco type and the shortness of shank which tends to keep the roots of the seedlings above the fertilizer layer.



Plate 71.

Fertilizer Placement Experiments.—A special plant setter used in fertilizer placement experiments. Water is carried in the barrel and fertilizer in the vertical cylinder. The plants are set by two operators seated midway along the machine. It is possible with this machine to regulate the depth and lateral position of the fertilizer bands.

Boron toxicity and the detrimental effect of sulphur in tobacco nutrition were observed in some experiments. At the Pee Dee Experiment Station symptoms of potash starvation were accentuated where large amounts (180 lb. per acre) of sulphur were included in the fertilizer.

In Tennessee a huge scheme under the control of the Tennessee Valley Authority involves the construction of several dams and the development of tremendous electric power. One aspect of this project is the manufacture of various phosphatic fertilizers with the electric current so generated. An extensive research programme is in progress in that State and elsewhere to test the efficiency of these products with various crops, including tobacco. Treble superphosphate and dicalcium phosphate are being found preferable to superphosphate for tobacco owing to their value in the manufacture of low sulphur content fertilizers.

At the Virginia Truck Experiment Station and the Windsor Tobacco Experiment Station rapid methods for the chemical analysis of plant tissue and soil for essential nutrients were noted with interest. At the latter station Swanback is evolving rapid colorometric micro-chemical tests which should be very helpful for the investigation of tobacco deficiency problems.

An excellent institution, which was resuscitated in 1935 after having lapsed for some years, is the holding of annual meetings of a Tobacco Research Committee. At these meetings, which are held at the latter end of the tobacco season, technical workers from various States, specialising in problems of tobacco production, assemble to discuss the past season's experimental results, to plan future work, and to make general recommendations for the future. Meetings of this nature tend to stimulate enthusiasm, have great educational value, and enable investigators to obtain a true perspective of their problems from a national viewpoint. Meetings are to be held in different tobacco-growing states each year, and will probably become a permanent annual function in the future.

[CONCLUDED.]

PRESERVATION OF BIRD LIFE—AN APPEAL.

To say that birds are the "farmers' best friends" is not an exaggeration. It is impossible to estimate the vast amount of good done by birds of all descriptions. That there has been an alarming decrease in the numbers of birds during the last few years, is obvious to anyone who is the least observant. That this decrease in bird life is due to needless and wanton destruction, together with the gradual clearing away of all undergrowth, which is most suitable for protection and nesting, is also evident to anyone who cares to take the trouble to notice it. Especially is this decrease due to the first-mentioned fact. Boys—and in many cases adults, who ought to know better—with catapult, air rifle, and pea-rifle, not to speak of those who rob the nests, are continually waging war on the birds, and it must be admitted that the harmless bird is fighting a losing battle.

These, among other things, were the subject of a lengthy discussion, which took place at the monthly meeting of the Merlwood L.P.A. We believe that much good would be done if the right kind of propaganda were kept before the public. We commend the work done by the "Bird Lovers' League." A vast amount of good has been done in the direction of the preservation of bird life—but we are of the opinion that much more could and should be done to educate the general public regarding the value of birds to the whole community, and particularly to those engaged in agriculture and other rural pursuits.

While we appeal for wholehearted support in this matter we would also appeal to all farmers to see to it that bird life on their own properties at least is preserved in its entirety.

We also appeal to all branches of the L.P.A. to take this matter up in their respective districts.—Bern. C. Shelton (Secretary, Merlwood L.P.A.), in the "South Burnett Times."

Queensland the "Queen State."

Prosperity out of a Tropic Jungle.

The "Daily Telegraph" (London) Supplement received in Brisbane recently features an article by the Premier of Queensland, Hon. W. Forgan Smith, headed—"Reaping Prosperity out of a Tropic Jungle." "Queensland, the 'Queen State' where every known Crop is Produced." "Wool Clip Doubled in Three Years."

The article reads—

"QUEENSLAND is the Queen State of the Australian Commonwealth. It has more than 500,000 square miles of country, exceeds the combined areas of France, Italy, Sweden, and Norway, has land producing every known crop, and, in addition, the Great Barrier Reef, a world wonder scenically and economically.

"In a short half-century Queensland has been converted from a tropic jungle to a smiling paradise. Primary production is the principal activity, but secondary industries are increasing gradually.

"Queensland produces 20 per cent. of the Australian wool production, 41 per cent. of the total cheese, 27 per cent. of the butter, 95 per cent. of the sugar-cane, and 56 per cent. of the total maize production.

"More than half the State is within the tropics, but the climate is extraordinarily mild and equable. There is almost perpetual sunshine, no snow, and a winter climate which makes the State the holiday land of Australia.

"The normal annual production of all industries is between £50,000,000 and £60,000,000, as follows:—

Pastoral, £15,000,000;
Manufacturing, £14,750,000;
Agricultural, £14,000,000;
Dairying, £7,000,000;

and the balance is distributed among various primary activities.

"Queensland possesses a larger area of first-class pastoral land than any other State. It has a belt of 1,000 miles of rich tropic land between Mossman and Point Danger, from which is produced 90 per cent. of Australia's sugar.

"Inland, agriculture, for a distance of 100 miles or so from the coast, holds sway, but still further inland sheep hold court. Wool is king.

"Since 1932 Queensland has made record progress towards prosperity. In 1931 the State's wool clip was worth only £5,000,000; in 1934, £10,000,000.

"The greatest proof of progress is the improvement in the Savings Bank accounts. Depositors at 10th January, 1935, had £25,878,000 to their credit—an increase of 7·6 per cent. for the year.

"Brisbane, the State capital and commercial centre, is picturesquely situated. It has civic control of the largest city area in the world.

"The population of the State is bordering on 1,000,000. Brisbane has more than 300,000 people.

"Queensland holds the premier position among the States in the Commonwealth in beef cattle raising.

"The beef cattle industry aims at producing meat of the quality wanted in Britain. To that end the herds have recently been built up by pedigree stock imported from Britain to ensure that the "baby beef" so popular on the English market will be in supply.

"As chilled beef is now more popular than frozen, the Queensland meat trade has made special efforts to improve chilling facilities on steamers. It has been proved that meat can be landed in excellent 'bloom' in England forty-five days after shipment.

"Great Britain normally imports about 500,000 tons of meat a year. Of that quantity 400,000 tons is foreign and 100,000 Empire production.

"Australia's share of the 100,000 tons is about 63,000 tons. Most of this comes from Queensland, where cattle stations are larger than some of the countries of Europe.

"Queensland also produces 40 per cent. of the Australian butter exported to Britain. This butter, under the Australian Government name of 'Kangaroo,' has won many prizes.

"Leading scientists in London recently made elaborate experiments with butter from all parts of the world, and Australian butter was proved to be the richest in health-giving qualities.

"During the year ended 30th June, 1935, Queensland manufactured 2,325,402 boxes of butter—a record. For the whole of 1934 production totalled 133,402,841 lb.

"Nearly 100,000 people of British parentage are engaged in the dairying industry in this State alone.

"Quensland, the northernmost State in Australia, produces nearly half the continent's cheese. Each year the State makes 12,000,000 lb. of cheddar, of which nearly 8,000,000 lb. are sent overseas."

The illustrations in the number include a picture of a sunset on the Great Barrier Reef, together with a wide range of pictures of Australian industries and scenery generally.

A panel draws attention to the Barrier Reef under the heading of "Coral Reef and Its Marvels," which reads:—

"Queensland possesses one of the marine wonders of the globe—the 1,200-mile Great Barrier Reef, the largest continuous mass of coral.

"The reef varies considerably in width. So does its distance from the coast. In the north it is within 20 miles of land, but to the south is 120 to 150 miles away.

"On the outer face the reef is often composed of nearly perpendicular walls rising from 20 to 25 fathoms to within a short distance of the sea-level. After 1,000,000 years of building the reef is still growing.

"The depths and shoals teem with fascinating marine life. The shape and colour have to be seen to be believed.

"Palm and mangrove and other vegetation grow on the atolls that dot the reef. Turtle, seabirds, and gaily-coloured fish abound."

The White Australia policy is very fully set forward by an article by Lt.-Col. T. W. White, Commonwealth Minister for Trade and Customs, whilst there is a special message to Britain from Mr. J. A. Lyons and also from the Treasurer, Mr. Casey, and Dr. Earle Page.

Mr. Malcolm MacDonald contributes a special message stressing Empire unity, and in which he says:—

"I, myself, retain the happiest recollections of my visits to Australia, when I not only enjoyed her justly famed hospitality, but obtained in my journeys through her varied countryside, from the vineyards and goldfields of Western Australia to the sugar plantations of Queensland, from the wide sheep country of New South Wales to the apple orchards of Tasmania, an invaluable insight into her problems, and some knowledge of their extent. It is for these reasons that I am happy to commend to all readers of the "Daily Telegraph" the articles in these Supplements.

"There can be no doubt that the Empire, and in a special degree Australia, offers splendid opportunities for mutually beneficial trade, and these papers, written by men of acknowledged authority, should help to encourage trade and develop communications between the United Kingdom and the Commonwealth. They should, and I hope they will, help even more to strengthen that consciousness of unity and comradeship, based on sympathetic understanding, which is the ideal of Empire inspiring all our aims."

DOWN WITH DIRT.

Down with dirt should be the slogan of all dairymen. Remember that milk is easily susceptible to contamination, and so affected loses its value with the resultant loss to the supplier. Be not content with the cleanliness of your milk cans and machines without, but see that every part within is also cleansed of all infectious matter, however minute. All deposits of manure in close proximity to any receptacle wherein milk is contained should be removed, lest flies and insects, after feeding therefrom, cause contamination. See that the rubbers of your milking machines before use are thoroughly cleansed of all particles of dirt; that the milk lines, air lines, and the releaser are scalded in case contamination result. Be sure to wash your separator with hot water, twice daily immediately after use. Before separating take particular care to have the separator bowl well swilled. Cleanliness of the individual is of no less importance than that of the machine; neither is everything that is clean outside an indication that everything is clean inside. When milking by hand, even an accumulation of dirt secreted under the nails should be removed, lest such dirt become moist and drop into the milk. Clean machines; clean containers for, and clean handling of, milk safeguard purity; pure milk makes a good quality product; a good quality product finds a ready market and fetches a better price than that of an inferior quality product; good quality products establish a high trading reputation to manufacturers. So important is cleanliness to the community that Government and civic authorities appoint inspectors that they might take precaution against infectious diseases caused through uncleanliness. The gospel of cleanliness has been preached since Biblical times, and still is. Remember Franklin's precept: "Tolerate no uncleanliness in body, clothes, or habitation." Take notice: "Cleanliness is next to godliness."—"The Unity Co-operator" (Toowoomba).

Studies on the Biology and Control of the Large Roundworm of Fowls, Ascaridia galli (Schrank 1788) Freeborn 1923.

F. H. S. ROBERTS, D.Sc., Animal Health Station, Yeerongpilly.

[*Continued from p.* 50, *Part I., Vol. XLVI.—July*, 1936.]

PART II.

3. THE PARASITIC PHASES IN THE LIFE CYCLE.

I. Technique Employed.

FOR the purposes of determining the parasitic life cycle and pathogenicity of *Ascaridia galli* incubated day-old white leghorn chickens were secured. For the first month the chickens were confined to a disinfected brooder battery or to thoroughly disinfected pens with concrete floors. Thereafter and until the termination of the experiments the birds were kept in compartments with batten sides and wire mesh floors. These compartments, the wire mesh floors, and trays beneath were thoroughly cleansed daily. When seven days old all chickens were numbered by means of aluminium wing bands.

Throughout the period of the investigation a dry mash was kept constantly before the birds. During the first month the composition of this mash was as follows: —

Maizemeal	63 parts
Pollard	13·5 parts
Bran	13·5 parts
Dried buttermilk	7 parts
Meat and bonemeal	3 parts

To this 1 per cent. common salt and 1 per cent. cod liver oil were added as supplements.

After the first month the quantity of dried buttermilk was reduced to 2·5 parts. The meat and bonemeal was increased to 5 parts, and an additional 2·5 per cent. of lucerne meal included. Small quantities of green lucerne were fed daily.

The dosages of eggs were computed by suspension following incubation of female worms at 37 deg. C. in physiological saline. The infective stage was secured by incubating fresh eggs in 2 mm. of 1 per cent. formalin at 30 deg. C. to 33 deg. C. The doses of infective eggs were delivered into the æsophagus on pellets of filter paper, which were then worked into the crop by means of the fingers.

Examination of the intestine, liver, &c., for larvæ was carried out in the following manner:—The intestine after being disengaged from the mesentery, gizzard, &c., was straightened out and cut into suitable lengths. Preliminary investigations showed the most suitable places for these incisions, in order to avoid cutting through any larvæ, to be in the vicinity of the entrance of the bile duct and just posterior to the yolk sac remnant. The contents of these sections were then forced out under pressure with warm physiological saline. The intestine was finally opened and thoroughly washed in saline.

The Baermann apparatus proved very efficient for the isolation of larvæ from the ingesta provided the larvæ were older than four days, the washings being placed in the usual stoppered funnel and placed at 37 deg. C. for approximately four hours. This method of isolation for newly-hatched and very young larvæ, however, was found to be unreliable, as it was observed in preliminary investigations that such larvæ appeared to a very large extent unable to free themselves from the mucous and ingesta, and only small percentages appeared in the liquid drawn off from the bottom of the funnel.

The body cavity was flushed out with warm saline, which was then centrifuged and examined for larvæ. The liver and lungs were examined both by means of pressed sections and the Baermann apparatus. The intestine wall was examined also by means of pressed sections.

II. The Parasitic Life Cycle.

(i.) Previous Investigations.

The first endeavour to ascertain the life cycle of *Ascaridia galli* appears to have been made by Scott.[95] Scott showed that this nematode may be transmitted to chicks by means of earthworms obtained from infected runs. He was not certain, however, whether earthworms acted as true intermediate hosts or simply as mechanical transmitters. A further report in 1915, however, indicated that Scott was inclined to consider that earthworms were not true intermediate hosts. Le Roux[72] has also shown that this roundworm may be disseminated by earthworms.

In 1920 a short note published by Ackert[1] showed that the life cycle of *A. galli* was direct. Ackert found that when the eggs are incubated at 28 deg. C. the larva is fully formed in nine days. Such embryonated eggs when fed to chicks hatch normally in the digestive tract, and twenty-eight hours after infestation numerous larvæ can be recovered from the small intestine. After thirty days the worms are about half grown. Examination of various organs for evidence of any larval migration outside the alimentary tract revealed only one larva in the lungs and one in the trachea, respectively, of two of the many chickens infested.

A report issued by the Oklahoma Experiment Station[84] in 1921, however, claimed mortalities among chicks fed infectious eggs due to a pneumonia, following a marked migration of the young larvæ to the lungs.

Two years later Ackert[3] published details of a further series of experiments, and with the exception of two larvæ isolated from the livers and six from the lungs of three chicks he could find no evidence of any migration from the intestine. The eggs were found to hatch in the duodenum, the larvæ preferring that portion of the intestine about one-fourth of the distance between the gizzard and base of the caeca, where the intestinal contents are slightly acid. Within a week after hatching the larvæ were observed to move deeply among the villi, and some were noted to penetrate the intestinal glands. During the next few days the penetrations of the mucosa by the larvæ increased in number and depth, and in the case of heavy infestations Ackert reported that the inner wall of the intestine may become studded with larvæ with their anterior ends buried in the wall tissues. On about the twentieth day the larvæ were observed to withdraw into the lumen of the intestine, where they remained till maturity, which was reached in about two months after infestation.

Guberlet[58] confirmed Ackert's work, and showed that normally the larvæ were found in the small intestine where for a short period they may become partially embedded in the mucosa. A few larvæ may penetrate the mucosa and reach other organs, as larvæ were occasionally found in the spleen, kidney, lungs, and body cavity, but this was regarded as an abnormal condition.

Danheim[46] was also unable to find any evidence of a general migration of larvæ from the intestine in a series of experiments in which infectious eggs were fed to rats.

In 1927 Itagaki[67] read a paper before the World's Poultry Congress at Ottawa on the life cycle of *Ascaridia galli* (*A. perspicillum*) in Japan. Itagaki recorded that during the hottest part of summer the egg becomes infective in seven days. Hatching occurs either in the glandular or muscular stomachs. The life cycle followed by the larvæ thereafter, Itagaki noted, was dependent upon the season of the year. During the spring and autumn the larvæ remain in the lumen of the intestine till maturity. During midwinter and midsummer, however, the larvæ penetrate the intestinal mucosa and nine to twelve days after infection are to be found in the mucous membrane and circular muscle layer, causing the formation of fibrous nodules which are distributed mainly throughout the lower third of the small intestine. In these nodules larvæ are to be found in early stages of development. The younger nodules are reddish and transparent, but in about thirty-six days after infection the nodules have become fibrous in nature, and may attain the size of a pin's head. The larvæ eventually return to the lumen and reach maturity after about thirty-seven days. Itagaki could find no evidence of any migration outside the intestine. In a further paper[68] Itagaki again drew attention to nodule formation extending into the cæca associated with the development of the larvæ of this roundworm.

Further work by Ackert[7, 8] supplied more detail, and the life history of *Ascaridia galli* was considered to be as follows:—At 33 deg. C. the eggs become infective in ten days. Hatching occurs mainly in the duodenum, the larvæ congregating in that portion a few centimetres posterior to the entrance of the bile duct in a practically neutral medium. For the first nine days the larvæ live in the lumen and in the inter-villar spaces. On the tenth day they commence to penetrate the mucosa between the villi, and during the next eight days may be seen with their heads buried in the mucosa and the rest of the body floating freely in the lumen. A few during this period may occur in the muscle layers or may even burrow through the intestine wall and be seen in the liver, lungs, and other organs. On the eighteenth day the larvæ move back into the lumen and remain there till maturity, which, in white leghorn chicks given a single dose of fifty eggs at one month old, is reached in fifty days. Ackert has recorded three moults, the first on the sixth to eighth day, the second on the fourteenth to fifteenth day, and the third on about the twenty-second day. At no time was any nodule formation as noted by Itagaki observed. Finally, Alicata[23] has shown that before the egg becomes infective the embryo moults, making four moults in all during the course of the life cycle.

(ii.) Experimental Infestations of Chickens.

A total of sixty-five chickens was used in these investigations to determine the parasitic life cycle of *Ascaridia galli*. The first lot of birds included under the numbers 1 to 37 consisted of cockerels which,

with the exception of Nos. 11, 13, and 15, were thirty days old when infested. These three birds were forty-five days old. Five control birds were autopsied at various periods before the experiment was commenced, and six others during the duration of the experiment. The infested birds were given a single dose of eggs from a culture held at 30 deg. C. to 31 deg. C. for twenty-one days, and for a further twenty-two days at room temperatures. These studies were conducted during November, 1934.

A second lot of birds, Nos. 190 to 217, all pullets and also thirty days old, were infested with a single dose of eggs during April, 1935. The eggs fed were portion of a culture incubated at 31 deg. C. to 32 deg. C. for sixteen days. Fourteen control birds accompanied this second study, being autopsied at various times prior and subsequent to infestation of the remaining birds.

As no worms were found in any of the control birds examined it was assumed that up to the time of infestation the birds used in these studies had remained entirely free from worms and that during the course of the investigation no accidental reinfestations had occurred.

The individual dosages of eggs fed and periods between infestation and autopsy are given in Table VII.

From the observations made in these studies the parasitic life history of *Ascaridia galli* is considered to be as follows:—

The First Stage Larva.

At a temperature of 31 deg. C. to 32 deg. C. the first movements of the embryo in the egg occur after four days. On the fifth day the early first-stage larva is considered to be present. At this stage of development the larva is comparatively stout, densely granulated in the middle two-thirds portion, and clearer in the region of the œsophagus and tail. After a further three days' incubation the larva is more slender in appearance, with a more definite intestinal region. The details of the œsophagus are difficult to make out, but it appears to be of the rhabdidoid type usual in first-stage nematode larvæ. After a total incubation period of eight days at these temperatures some of the larvæ commence to moult, which procedure becomes more generalised on the ninth day. This moult marks the appearance of the second stage larva, which remains in the egg shell enclosed in the moulted skin of the previous stage. At a higher temperature of 33 deg. C. the first moult was observed as early as the seventh day.

The Second Stage Larva.

The Infectivity and Hatching of the Embryonated Egg.

That the second-stage larva is the infective stage was demonstrated by feeding eggs which had been incubated for six, seven, eight, and nine days at 31 deg. C. to 32 deg. C. to chickens fourteen days old. Hatched larvæ were recovered only from chicks to which eggs nine days old had been fed. That is, the larva becomes infective shortly after it has completed its first moult.

When infectious eggs are fed to chickens many of them remain unhatched, and may be recovered from the fæces. The majority, however, hatch successfully, and observations have shown that although a few free larvæ may be found in the gizzard the greater number occur in the small intestine. As early as one and one-half to two hours after

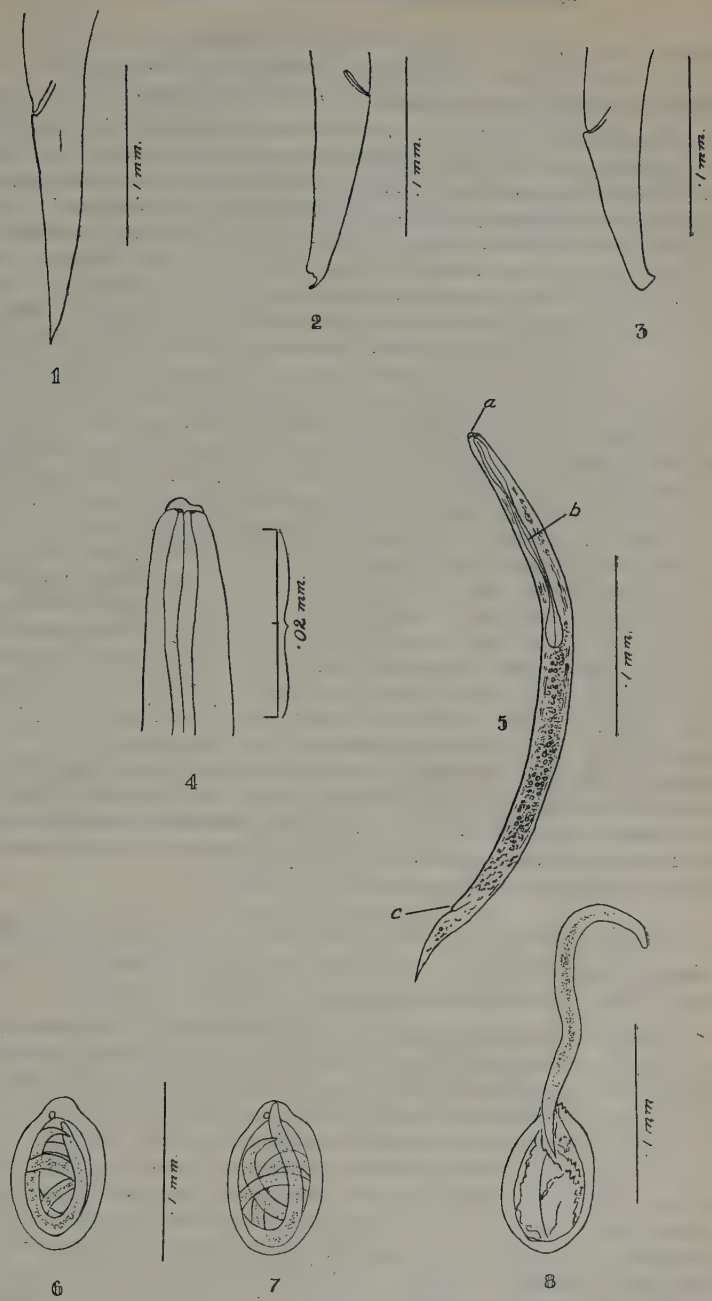


Plate 72.

Fig. 1. Normal tail of second stage larva.
Figs. 2 and 3. Abnormal tails of second-stage larva.
Fig. 4. Cephalic extremity of second-stage larva, showing oral prominence.
Fig. 5. Second-stage larva, newly hatched.
(*a*) Oral prominence. (*c*) Anus.
(*b*) Oesophagus.
Figs. 6, 7, and 8. Hatching of larva, following moistening after desiccation.

infestation free larvæ may be recovered from this portion of the alimentary tract, being congregated mainly in that portion 6 to 12 centimetres posterior to the entrance of the bile duct.

Hatching frequently occurs in water cultures of eggs, and is especially prominent among infectious eggs which have been agitated to secure an even suspension. The moistening of infectious eggs which have been subjected to periods of desiccation is also very conducive to hatching, and in such cases the percentage hatching appears to be governed solely by the duration of the conditions of dryness. In such cases hatching proceeds as follows:—The larva is usually in such a position that its anterior end is adjacent to the opercular plug of the egg shell. Gradually this end of the shell bulges and the vitteline membrane is pierced by the larval head. The head is then placed in this bulged part of the shell, which eventually bursts, splitting in the region of the opercular plug. By lashing movements of the body interspersed with frequent resting periods the larva gradually frees itself from the shell, leaving behind the moulted skin of the first-stage larva in which it was enclosed. This procedure is illustrated in Plate 1, figs. 6, 7, and 8. Occasionally the shell may bulge at both ends, giving the impression of some force exerted by the larval head and tail. As dead larvæ may also hatch in a similar manner and under similar conditions it is apparent that this hatching is due to some reaction of the shell to moisture, and not to any effort on the part of the larva. Hatching may also be readily brought about by gentle pressure, but in such instances it has been found that the shell may rupture at any point, whereas hatched shells obtained from the intestine always show a splitting of the shell in the region of the opercular plug. The conditions governing the hatching of the egg in the alimentary tract of the host are not understood, and it is suggested that hatching may be due to the nature of the egg shell which, in the presence of certain substances in the alimentary tract, reacts in much the same way as it does in the presence of moisture after a period of dryness.

Description of the Second Stage Larva. (Plate 72, fig. 5.)

Newly hatched larvæ measured 285μ to 378μ in length, the average length of forty-five specimens measured being 323μ.

The body is smooth, elongate, and cylindrical, tapering gradually to the head and ending in a conical tail. The mouth appears to be a simple pore surmounted by a chitinous structure somewhat similar to the so-called "boring tooth" of the second-stage larva of *Ascaris lumbricoides*. This structure is illustrated in Plate 72, fig. 4, showing that it is more prominent towards the ventral surface. The œsophagus is slender with an inconspicuous anterior swelling and a posterior bulb. The body contains numerous granules which are concentrated mainly in the region of the intestine, leaving the œsophageal and caudal portions of the body relatively clear. The intestine reaches the exterior per medium of an inconspicuous rectal cavity and anus, the position of the latter being marked by slight though prominent lips. Extending the entire length of the body are a pair of faintly visible lateral lines.

Measurements.—Length 378μ, œsophagus 128μ, anus 58μ, maximum width 20μ.

As mentioned in the above description the tail of the second-stage larva is conical and straight (Plate 72, fig. 1), but on rare occasions larvæ with tails as in Plate 72, figs. 2 and 3 have been seen, not only among larvæ hatching in water cultures, but also among larvæ up to

five days old in infested chickens. The significance of these different types of tails is not understood.

During the next few days the larvæ are to be found in the lumen of the intestine and in the intervillar spaces. Growth during the early portion of this period is comparatively slow. At the end of twenty-four hours larvæ may measure up to 385μ long, and the excretory pore and genital rudiment have appeared. At this stage the genital rudiment is a colourless ovoid body, and in a larva 328μ in length is situated at about 117μ from the tail. After three days the larvæ have reached 555μ (average 435μ) in length by about 30μ in width. The body is now more heavily cuticularised, the lateral lines are more distinct, and the nerve ring can be made out with difficulty.

After five days there are distinct changes in structure. The body is more slender and the œsophagus is relatively shorter. The intestinal cells are more compact and the intestinal lumen and body cavity are apparent. The genital rudiment now consists of a number of cells, and the nerve ring can be readily made out. At this time larvæ may measure ·85 mm. to 1·17 mm. in length, averaging ·98 mm. The following measurements were taken from a larva 1·17 mm. in length:—Length, 1·17 mm.; œsophagus, ·185 mm.; nerve ring, ·084 mm.; anus, ·122 mm.; genital rudiment, ·462 mm. (from tail).

Among the five-day larvæ examined several were almost hyaline in appearance, indicating that a moult had just taken place, and on the sixth day fully 75 per cent. of the larvæ recovered had either completed the second moult or were enclosed in the moulted skin of the previous stage. The third-stage larvæ measured up to 1·86 mm. in length, and the second-stage larvæ up to 1·2 mm. in length, respectively. By the ninth day all larvæ were in the third stage, with a maximum length of 5·22 mm. (average 3·6 mm.).

A description of the third-stage larva is given below: —

The body is now very elongate and slender. The oral prominence has disappeared, and the mouth is now surrounded by three very shallow lips—one large dorsal lip and two equal sub-ventral lips, each of which is conspicuously lined with cuticle along its edge. The œsophagus is relatively small and slender in appearance (Plate 74, fig. 2). The nerve ring is prominent. The genital rudiment now consists of an elongate, ovoid mass of cells which in some larvæ may continue anteriorly and posteriorly for varying distances as a single row of cells lying ventrally between the intestine and body wall. The lateral membranes have also increased in size, and their width, 8μ to 12μ, makes them very conspicuous.

The sexes may now be readily distinguished. In both male and female third-stage larvæ the tail is somewhat sickle-like in shape, the curvature being more pronounced in the male. (Plate 73, figs. 1 and 2.) In the male there is also a pre-anal swelling, the rudiment of the pre-anal sucker. (Plate 73, fig. 1.) In the female thereis a rudimentary genital opening in the region of the genital primordium.

The measurements of a female larva nine days old and 4·06 mm. in length are given.

Length, 4·6 mm.; œsophagus, ·34 mm.; nerve ring, ·16 mm., anus, ·19 mm., genital rudiment, 1·8 mm. (from tail); rudimentary genital opening, 1·83 mm. (from tail); width in region of posterior portion of œsophagus, ·075 mm.; width of head, ·033 mm.

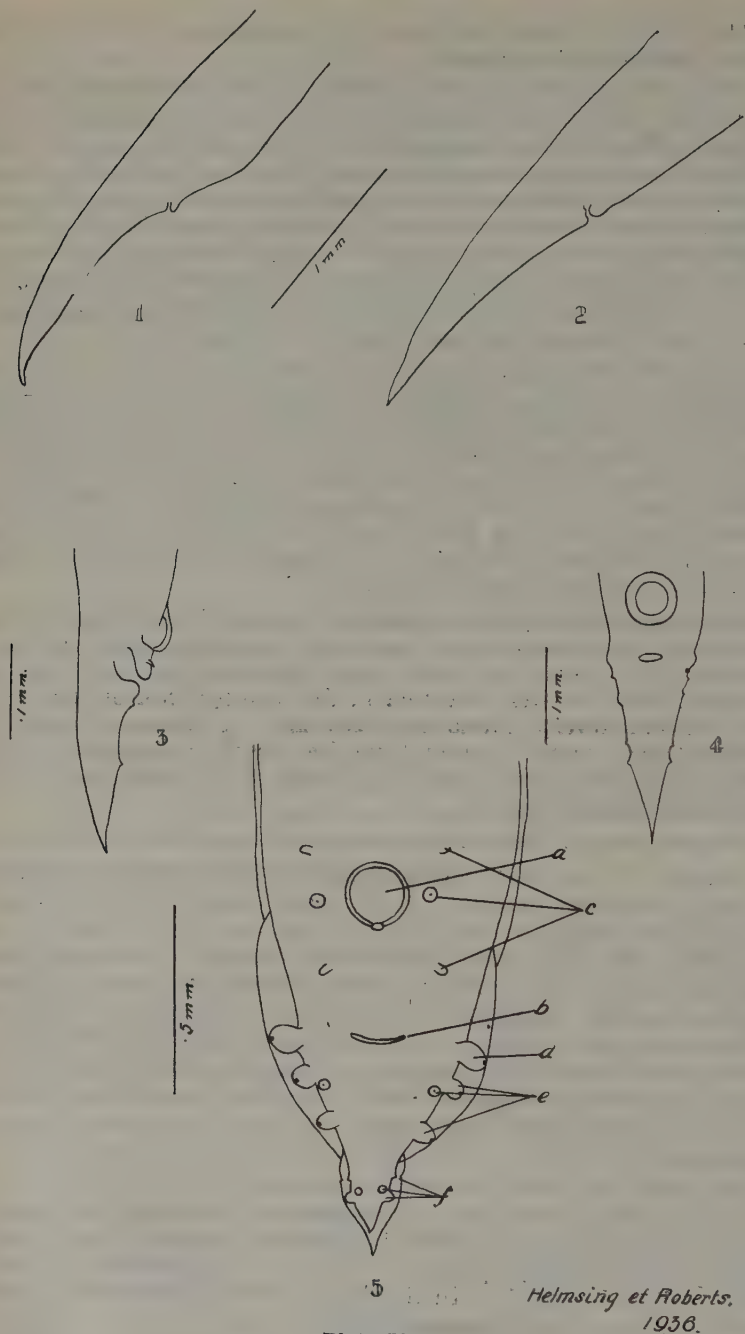


Plate 73.

Fig. 1. Tail of third-stage male larva showing pre-anal swelling.
Fig. 2. Tail of third-stage female larva.
Fig. 3. Tail of fourth-stage male larva.
Fig. 4. Tail of fourth-stage male larva at a later stage of development.
Fig. 5. Tail of adult male.

(*a*) Pre-anal sucker.
(*b*) Anus.
(*c*) Pre-anal papillæ.
(*d*) Anal papillæ.
(*e*) Post-anal papillæ
(*f*) Sub-terminal papillæ.

Larval Migration.

Observations made on chickens infested during November and autopsied ten to nineteen days after infestation show that during this period the larvæ attack and may penetrate the intestine wall to varying degrees.

An examination of chicken No. 9, autopsied ten days after infestation, showed that although after flushing the intestine with warm physiological saline numerous free larvæ could be recovered, other larvæ were present with their heads buried into the intestine wall between the villi and with the remainder of the body floating freely in the lumen. (Plate 75, fig. 1.) Whilst such attached larvæ were being examined in warm physiological saline under the binocular microscope the majority readily freed themselves and swam away.

During the next eleven days eleven chickens were autopsied. Up till the nineteenth day after infestation larvæ were observed attacking the intestine wall, though of the two chickens killed on this day only one gave evidence of larval penetration, two larvæ being detected in pressed sections of the intestine wall of chicken No. 18.

In the birds slaughtered after the nineteenth day all larvæ appeared to be living freely again in the lumen of the intestine.

In all birds examined between the tenth and nineteenth days the relations of the larvæ to the intestine wall were essentially the same as those recorded for the larvæ observed in chicken No. 9 (ten days' infestation). The liver, lungs, and body cavities of all these birds were carefully examined for any evidence as might suggest a normal larval migration outside the alimentary tract, but with the exception of one larva recovered from the abdominal cavity of chicken No. 10 (twelve days' infestation), two larvæ from the lungs of chicken No. 13 (thirteen days' infestation), and one larva from the lungs of chicken No. 15 (fifteen days' infestation), no such evidence was secured.

Microscopic examination of the intestine wall showed the majority of the larvæ lying between the villi with their anterior ends buried into the crypts of Lieberküln. (Plate 75, fig. 2, and Plate 76, figs. 1 and 2.) In a few sections larvæ were observed which had penetrated the wall more deeply and were lying in the muscle layers (Plate 77, fig. 1) and in a mesenteric fold (Plate 77, fig. 2.)

In the experiments conducted in April-May, 1935, no larvæ were recovered at any time outside the alimentary tract. It was also observed that among these birds the tendency for the larvæ to attack the intestine wall during the period subsequent to the ninth day after infestation appeared less obvious than among the birds infested in November. No larvæ at any time were observed completely buried in the mucosa or submucosa, and although an occasional larva was seen with its anterior end shallowly buried into the wall between the villi, the majority of the larvæ appeared to be free in the intestinal lumen. No evidence of larvæ attacking the intestine wall, moreover, was observed in the series after the seventeenth day.

Among the ten-day larvæ it was observed that the female larvæ were in general larger than the male larvæ. In the females the genital cells are now more extensive in their distribution, and the genital opening is marked by a vulva and short vagina. In the males the pre-anal swelling is more conspicuous, and in some of the males there is a tendency for the old cuticle to split away in this vicinity.



Fig. 1. Portion of small intestine showing larvæ attacking the intestinal wall.

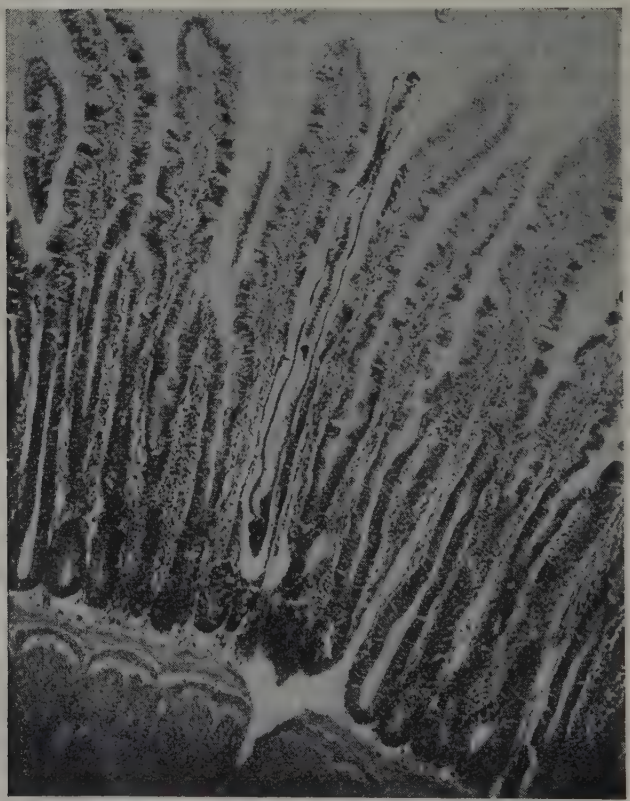


Fig. 2. Longitudinal section of larva in glandular crypt.

Plate 74.

The third moult was observed to occur on the twelfth day, when two female larvæ, 5·8 mm. and 6·1 mm. long, respectively, were noticed completely enclosed in the moulted skin of the third stage. On the thirteenth day many third-stage larvæ were still present, but 70 per cent. of the larvæ examined were either in the fourth stage or moulting. Larvæ at this stage measured:—

Third Stage—

Males, 3·6 mm. to 5·4 mm., average 4·9 mm.
Females, 4·5 mm. to 6 mm., average 5·3 mm.

Fourth Stage—

Males, 5·9 mm. to 8·2 mm., average 7·2 mm.
Females, 5·6 mm. to 11·1 mm., average 8·06 mm.

Description of the Fourth-Stage Larva. (Plate 74, fig. 3.)

The following description is taken from fourth-stage larvæ thirteen days old.

The cuticle is now showing numerous very fine transverse rings. The lips are of the adult type, being rather deep and strongly lined with cuticle with dentigerous ridges. The lip papillæ have appeared. The œsophagus is relatively short and somewhat club-shaped. (Plate 74, fig. 4.) The lateral membranes are now greatly reduced in prominence.

The Female.—The female genital opening is now marked by a prominent vulva. There is a short muscular vagina which leads into the uterus which in some specimens is well developed and conspicuous. The tail is straight and much shorter in comparison to the rest of the body than in the third stage.

Length, 10·48 mm.; œsophagus, ·84 mm.; nerve ring, ·24 mm.; anus, ·25 mm.; vulva, 4·3 mm. (from tail); width of head, ·05 mm.

The Male.—In the male the pre-anal sucker is now apparent, and there are three pairs of caudal papillæ. The first pair are situated just in front of the anus, the second pair immediately posterior to the anus, and the third pair midway between the anus and the tip of the tail. (Plate 73, fig. 3.)

Length, 7·48 mm.; œsophagus, ·76 mm.; nerve ring, ·23 mm.; anus, ·24 mm.; width of head, ·045 mm.

On the fifteenth day females measured 9·7 mm. to 13·23 mm. in length, with an average length of 11·7 mm., and males 9·48 mm. to 12·9 mm. in length, with an average length of 9·48 mm. In the males of this age it was observed that the spicules were appearing and that in a few of the specimens examined traces of two more caudal papillæ were apparent, one between the pre and post-anal papillæ, and a further subterminal papilla. (Plate 73, fig. 4.)

By the sixteenth day larvæ measured up to 14·2 mm. in length. Eighteen days after infestation several larvæ were observed undergoing their fourth moult. Males at this time measured 16·2 mm. to 22·5 mm. in length (average 18·5 mm.), and females 18·5 mm. to 25·6 mm. in length (average 21·7 mm.). In the chicken autopsied on the twenty-first day, No. 214, all the worms were young adults, and ranged in size from 27·4 mm. to 35 mm.

The Young Adult.

The following description is taken from larvæ twenty-three days old.


e
f
5 mm
1
d
c
a
a
c
1 mm
d
2
f
5 mm
3
a
b
d
c
c
a
b
d
5 mm.
4
Helmsing et Roberts
1936.

Plate 75.

Both sexes are now similar in general characteristics to the mature adult. In the females the vulva, vagina, uteri, and ovarian tubes are all well developed. The male genitalia is also well advanced in development, and the caudal alæ, ten pairs of caudal papillæ, and the spicules are all prominent. (Plate 73, fig. 5.) In both sexes the body cuticle is now encircled by very definite rings more widely spaced than in the previous stage.

A female 37·5 mm. long gave the following measurements:—Length, 37·5 mm.; œsophagus, 2·1 mm.; nerve ring, ·5 mm.; vulva, 18·6 mm. (from tail); width of body at posterior end of œsophagus, ·42 mm.; width of head, ·17 mm.

Maturity Period.

In chicken No. 23, infested during November with 100 eggs, and autopsied on the twenty-sixth day after infestation, female worms had attained a length of up to 51·5 mm., and in a female of this length fertile eggs were observed in the uteri, but no eggs were recovered from the fæces. Another bird in this series also given 100 eggs and autopsied on the twenty-eighth day (No. 25) yielded only four worms, the largest female being 52·6 mm. in length. This female contained many fertile eggs in the uteri, and an examination of the fæces showed that fertile eggs were being passed. By the thirtieth day females in a bird given fifty eggs had attained a length of 65·2 mm., and fertile eggs were very numerous in the droppings (No. 26).

Observations made in May with chickens fed 100 infective eggs revealed a few fertile eggs in the droppings of a bird autopsied on the twenty-seventh day (No. 217). The infestation consisted of three females, 50·2 mm., 51·6 mm., and 53·2 mm. and four males, 35·1 mm., 46·3 mm., 47·4 mm., and 48 mm. in length, respectively.

Discussion.

Reviewing the work of previous investigators we find that the life history of *Ascaridia galli*, as given by the Oklahoma Experiment Station, Ackert, and Itagaki differs in several points. As determined by the writer, the life history is not entirely in agreement with that recorded by Itagaki or Ackert, but there was certainly no evidence of a consistent extra-intestinal migration analagous to that occurring in the life history of *Ascaris lumbricoides*, as recorded by the Oklahoma Experiment Station.

Hatching appears to take place chiefly in the small intestine, though as a few newly-hatched larvæ were found in the gizzard some eggs may also hatch in the crop or in the glandular or muscular stomachs. Until the tenth day the larvæ live freely in the lumen of the intestine or in the intervillar spaces.

The experiments conducted in November, 1934, showed very definitely that from the tenth to the nineteenth day the larvæ attack the intestine wall. During this period, as determined by macroscopic

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DESCRIPTION OF PLATE 75.

Fig. 1. Third-stage larva.

Fig. 2. Cephalic extremity of third-stage larva.

Fig. 3. Fourth-stage larva.

(*a*) Mouth
(*b*) Oral papillæ.
(*c*) Nerve ring.
(*d*) Oesophagus.
(*e*) Genital cells.
(*f*) Female genital opening.

Fig. 4. Cephalic extremity, fourth-stage larva.



Fig. 1. Section of small intestine showing larva.

and microscopic observations, many of the larvæ are to be seen with their anterior ends buried into the crypts of Lieberküln and with the remainder of the body floating freely in the lumen. That this penetration is usually very shallow is denoted by the fact that many of these larvæ can readily withdraw from the intestine wall and become free.

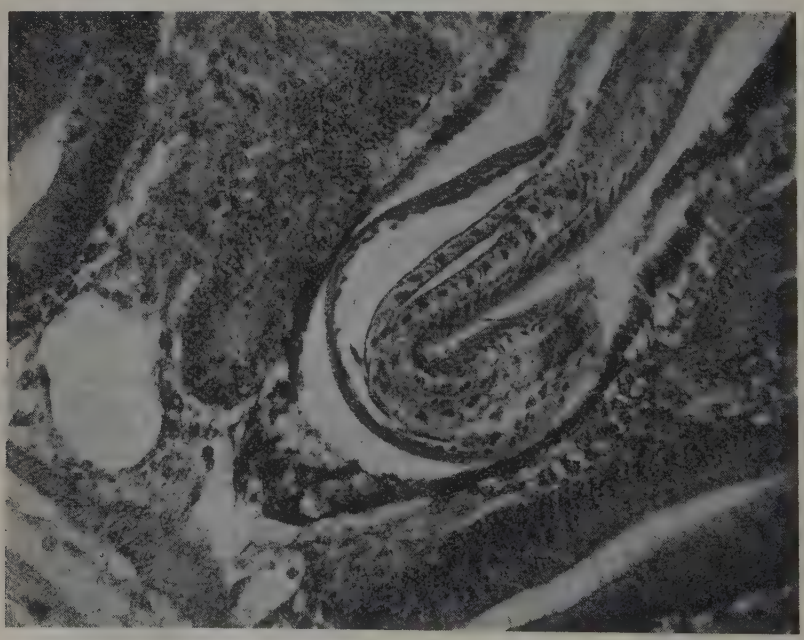


Fig. 2. Section of small intestine showing destruction of glandular epithelium by larva.

Plate 76.

The occurrence of free larvæ in the lumen of the intestine during this period, together with the above observation, may possibly indicate that the larvæ are not confined to any one spot on the intestine wall—that is, they do not become fixed, but may attack the intestine wall in several places. A few may penetrate through to the longitudinal muscle layer, and rarely some of these may continue their burrowing activities to reach organs lying in the body cavities.

In the chickens autopsied in the May series of experiments evidence of larval penetration of the intestine wall was not so striking. The majority of the larvæ in chickens autopsied during the tenth to the seventeenth day were apparently free in the lumen occurring among the ingesta. A few were observed up till the seventeenth day with their anterior ends buried into the mucosa between the villi, but in most cases such larvæ quickly became free whilst under observation. No larvæ in any bird were detected deeply buried in the wall tissues.

It will be remembered that Itagaki recorded that during the extremes of summer and winter in Japan the larvæ attack the intestine wall, whilst during spring and autumn they remain throughout their life cycle free in the intestinal lumen. It appears most improbable that any parasitic worm with a direct life cycle should be dependant upon the season of the year to an extent as would involve some alternation in the life cycle, yet the observations by the writer made on birds infested in November and May appear at first sight to indicate that during the autumn (April, May) the tendency for the larvæ to attack the intestine wall is less striking than during the summer (November). These observations, however, are somewhat confused by the wide variations in the number of eggs used as the single dose. In the November experiments, for example, it was noticed that the greater the number of eggs fed the more evident was the behaviour of the larvæ during the tenth to the nineteenth day. For example, in chickens Nos. 13, 15, and 11, which received dosages of 10,000 to 15,000 eggs, some hundreds of larvæ were observed attacking the intestine wall, and portions of intestine were able to be fixed with the majority of these larvæ still *in situ*. With those chickens fed 1,000 eggs comparatively few larvæ were observed actually attacking the intestine wall, and many of these quickly detached themselves whilst under observation. It is therefore considered that the observations made on the comparatively few larvæ recovered from the April-May series of chickens, which were fed a single dose of 100 eggs only, may not have been conducive to a true interpretation of larval behaviour during the tenth to nineteenth day.

As further evidence that the behaviour of the larvæ in the host is probably identical during summer and autumn, it will be observed, if Table VII. is consulted, that after the tenth day there is a sudden and conspicuous decrease in the number of larvæ present. This is true of both the November and April-May experiments. This decrease is considered to be due (this will be discussed in greater detail later) to a resistance on the part of the bird developed as a result of larval attack on the intestine wall.

After the nineteenth day the larvæ live freely in the lumen of the intestine, and favour that portion of the intestine in the vicinity of which the majority of the newly-hatched larvæ had congregated.

When the egg is incubated at 33 deg. C. in 2 mm. of 1 per cent. formalin the first larval moult occurs after seven days. The second moult was observed as early as the fifth day after infestation, the third

on the twelfth day, and the fourth on the eighteenth day. These various periods for the respective moults are somewhat earlier than those recorded by Ackert.

The minimum maturity period established was twenty-seven days, mature females measuring 51 mm. to 53 mm. In his work on the life history published in 1931 Ackert[7] used white leghorns, which were infested with a single dose of fifty eggs when one month old. The minimum maturity period observed by him was about fifty days. The maturity period of twenty-seven days was obtained by the writer in birds of the same breed and age, and given a single infestation of 100 eggs. Itagaki[67] recorded maturity in thirty-seven days, but did not state the age of the birds nor the number of eggs with which this figure was obtained. In the light of the very similar conditions governing both Ackert's and the writer's experiments it is very difficult to find an explanation for this discrepancy. Similar discrepancies have been noted by Baker[27] in the figures given by various workers for mature growth of the cæcum worm of fowls, *Heterakis gallinæ,* namely twenty-four to sixty-one days. Baker has noted, however, that the presence of blackhead may retard the development of this roundworm, and thinks that this may partly explain the variations observed.

Summary.

1. When the egg of *Ascaridia galli* is incubated at 31 deg. C. to 32 deg. C. the second-stage larva appears after eight days. This is the infective stage. At 33 deg. C. the first moult occurs after seven days.

2. These infective eggs when fed to chickens hatch mainly in the small intestine, the larvæ for the most part inhabiting that portion of the small intestine a few centimetres posterior to the entrance of the bile duct. A few eggs may hatch in either the crop, glandular stomach, or gizzard.

3. For the first nine days the larvæ live freely in the lumen of the intestine or in the intervillar spaces.

4. From the tenth to the nineteenth day the larvæ attack the intestine wall. The majority make their way into the crypts of Lieberküln, burying their heads shallowly into the tissues, with the remainder of the body floating freely in the lumen. During this period numbers of larvæ may also occur freely in the lumen. A few larvæ may burrow more deeply into the wall tissues, and some may completely penetrate it to occur eventually in the liver, lungs, &c. There is some slight evidence that this migration tendency is associated to some extent with the number of larvæ present, being most conspicuous where a very large dose of eggs has been administered.

5. After the nineteenth day the larvæ withdraw from the intestine wall, and are to be found only in the lumen.

6. Four moults have been observed. The first moult occurs in the egg in the minimum period of seven days. The second, third, and fourth moults take place in the small intestine at about five, twelve, and eighteen days after infestation, respectively.

7. The minimum period of maturity in white leghorn chicks infested at thirty days of age with a single dose of 100 eggs is twenty-seven days.

8. Nodule formation, as recorded by Itagaki,[67, 68] was not observed.



Fig. 1. Section of small intestine showing the migration of larva into the muscle coat.

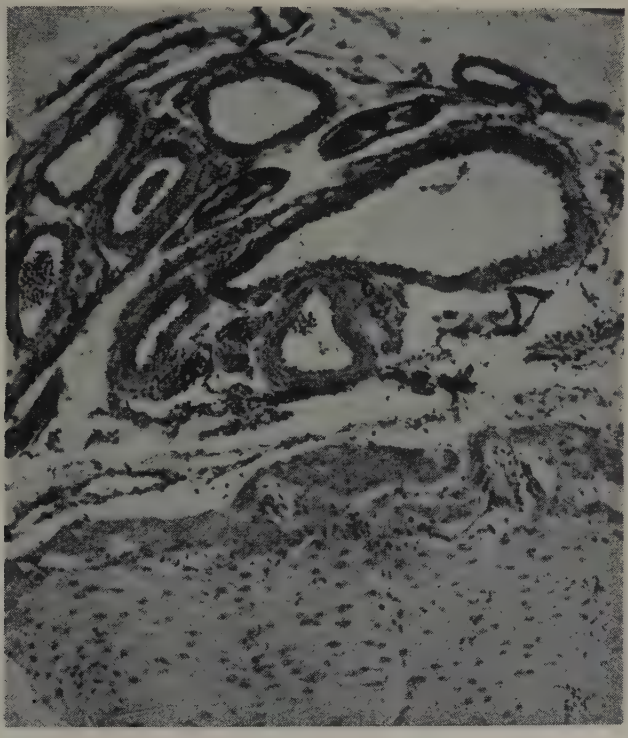


Fig. 2. Section of small intestine showing larva in mesenteric fold.

Plate 77.

In Table VII. set out below is summarised the number of worms and their respective lengths, as obtained from each bird used in these life history studies.

TABLE VII.

No. of Bird.	No. of Eggs Fed.	Period of Infestation.	Month Observations Made.	No. Worms Secured.	Lengths.		
					Minimum.	Maximum.	Average.
1	10,000	2 hours	October ..	Hundreds	285μ (Newly hatched larvæ)	378μ	323μ
2	2,000	24 hours	November ..	356	300μ	380μ	328μ
203	100	24 hours	April ..	72	305μ	385μ	332μ
3	2,000	2 days	November ..	712	310μ	396μ	350μ
204	100	2 days	April ..	57	310μ	415μ	385μ
4	2,000	3 days	November ..	316	437μ	555μ	490μ
5	2,000	5 days	November ..	230	·85 mm.	1·17 mm.	·98 mm.
6	2,000	6 days	November ..	180	·97 mm.	1·5 mm.	1·11 mm.
205	100	6 days	April ..	44	·9 mm.	1·86 mm.	1·22 mm.
206	100	7 days	April ..	37	1·98 mm.	2·81 mm.	2·4 mm.
7	2,000	8 days	November ..	150	1·73 mm.	3·85 mm.	2·9 mm.
207	100	8 days	April ..	42	2·39 mm.	4·06 mm.	3·39 mm.
8	2,000	9 days	November ..	140	3 mm.	5·22 mm.	3·6 mm.
9	2,000	10 days	November ..	125	1·75 mm.	4·08 mm.	3·35 mm.
208	100	10 days	April ..	34	4·12 mm.	6·35 mm.	4·94 mm.
10	1,000	12 days	November ..	65	3·1 mm.	6·46 mm.	4·6 mm.
11	10,000	12 days	November ..	Numerous	..	..	..
12	1,000	13 days	November ..	168	5·6 mm.	11·1 mm.	8·06 mm.
13	15,000	13 days	November ..	Numerous	..	..	..
209	100	13 days	April ..	6	4·48 mm.	5·62 mm.	5 mm.
210	100	13 days	April ..	14	5·21 mm.	9·9 mm.	8·31 mm.
14	1,000	15 days	November ..	16	3·06 mm.	6·06 mm.	4·3 mm.
15	10,000	15 days	November ..	Numerous	..	..	..
211	100	15 days	May ..	10	9·48 mm.	13·23 mm.	11·27 mm.
212	100	16 days	May ..	4	9·72 mm.	14·2 mm.	11·7 mm.
16	1,000	17 days	November ..	23	7·2 mm.	13·8 mm.	10·9 mm.

213	100	18 days	May ..	14	16·2 mm.	22·5 mm.	18·5 mm.
17	500	19 days	November ..	14	14·5 mm.	19·3 mm.	16·4 mm.
18	500	19 days	November ..	28	12·8 mm.	19·4 mm.	17·2 mm.
214	100	21 days	May ..	16	27·4 mm.	35 mm.	31·2 mm.
19	500	21 days	November ..	3	16·8 mm.	20·4 mm.	18·3 mm.
20	500	21 days	November ..	25	15·4 mm.	18·6 mm.	17 mm.
21	500	23 days	November ..	8	21·6 mm.	37·5 mm.	27·3 mm.
215	100	23 days	May ..	30	23·5 mm.	40·2 mm.	30·4 mm.
22	500	26 days	November ..	3	12·8 mm.	19·2 mm.	16·1 mm.
23	100	26 days	November ..	21	28·2 mm.	51·5 mm.	46·4 mm.
216	100	27 days	May ..	3	22·6 mm.	34·1 mm.	28·4 mm.
217	100	27 days	May ..	7	35·1 mm.	53·2 mm.	47·4 mm.
					Eggs in fæces		
24	500	28 days	November ..	23	24·5 mm.	28·2 mm.	26·6 mm.
25	100	28 days	November ..	4	38·4 mm.	52·6 mm.	49·7 mm.
					Eggs in fæces		
26	50	30 days	November ..	16	44·2 mm.	65·2 mm.	52·8 mm.
					Eggs numerous in fæces.		

Recent Developments in the Treatment of Tick Fever.

C. R. MULHEARN, B.V.Sc., Animal Health Station, Yeerongpilly.

FOR many years it was considered that all cases of tick fever in Australia were caused by a single organism, but it is now well known that there are five distinct organisms each capable of causing a distinct type of tick fever in this country. Two of these organisms give rise to a mild form of the disease, and probably never cause any mortality in stock. The other three give rise to the very serious forms of the disease known as Babesiellosis, Piroplasmosis, and Anaplasmosis.

Anaplasmosis is frequently not recognised as a type of tick fever, for the symptoms come on slowly, and are in the form of gradual emaciation accompanied by fever and sometimes jaundice. Red urine is never passed, even in fatal cases. In the present state of our knowledge no specific drug treatment is known for this disease, and it is not intended to discuss it further in this article.

The other serious types of tick fever are closely related, and both attack the animal very suddenly, displaying symptoms of loss of appetite, high fever, and distress. The climax is reached in less than a week, so that death occurs or signs of recovery are noted soon after this period. Red urine is always passed in serious cases of piroplasmosis, and usually also in babesiellosis, although occasional fatal cases of the latter disease have occurred without red urine being evident.

It is not possible to distinguish between these two types of tick fever without the aid of a microscope, consequently only a general diagnosis of tick fever can be made in the field. However, an examination of specimens at the Animal Health Station, Yeerongpilly, received from natural cases indicates that babesiellosis is by far the most common form encountered in Southern Queensland.

It has long been known that the true form of piroplasmosis can readily be controlled by trypanblue and its derivatives, but that these drugs are of no value in the treatment of babesiellosis.

Treatment of Piroplasmosis with Piroblue.

The piroplasmosis type of the disease is one of two that is regularly used and recommended for the protective inoculation of stock against all forms of Queensland Tick Fever (for this aspect of tick fever advisory leaflets Nos. 15 and 17 should be consulted).

In carrying out such inoculations it frequently happens that severe reactions are produced, particularly in stud animals, for as a general rule they are very susceptible, and it becomes necessary to check such reactions by drug treatment. For this purpose piroblue, a derivative of trypanblue, has been used with great success during the last few years. The dose rate of this drug is 100 c.c. of a 1 per cent. solution, and in order to be most effective it must be injected directly into the jugular vein. To carry out this treatment 1 gram of the drug, which is supplied in a powder form, must be dissolved in 100 c.c. (about half an ordinary breakfast cup) of clean water which has been boiled and allowed to cool to blood heat. This solution should be made up immediately before

use, for the drug does not keep well in the liquid form. A stout hypodermic needle, preferably about 3 inches long, and a syringe are necessary to inject the solution into the vein. Before this is attempted the animal should be well restrained and a piece of cord is attached around the lower portion of the neck and twitched tightly so that the jugular vein will stand out prominently. The needle is then inserted into the vein, and when this is successfully carried out the blood will flow readily from the free end of the needle. The cord should be then released and the piroblue solution injected into the vein. This operation presents no difficulty to the trained person, provided that the animal is well restrained and the necessary instruments are available, and it is usually completed within a few minutes. However, considerable difficulty may be experienced in attempting this operation in the field when conditions are not the most desirable. If it is not possible to inject the drug into the vein it should be injected into several places under the skin, but this method is not nearly so effective in controlling the disease as the intravenous method.

If the disease is well advanced it is essential that the drug should be injected into the vein, for otherwise the animal may die before it could be absorbed into the circulation. Red urine must always be looked upon as a very serious symptom, and treatment should be carried out without delay when it is observed.

When the drug is successfully injected the animal usually shows considerable improvement in from twelve to twenty-four hours, the temperature drops to normal, and the parasites disappear from the circulating blood. In occasional cases this improvement does not follow the first treatment, and it then becomes necessary to give a second treatment. This second treatment should be carried out if the animal is not considerably improved within twenty-four hours of the first treatment. Piroblue, like trypanblue, is only effective in the treatment of piroplasmosis, and it has no value in the treatment of babesiellosis, consequently, when cases of redwater are encountered in the field and no microscopic diagnosis is available, disappointing results may follow its use.

The Aciron Treatment of Tick Fevers.

During the past few years considerable success has been obtained in other countries in the treatment of tick fever with a preparation known as Aciron. This drug has been specially prepared for this purpose, and early in the present year supplies were obtained in order that it might be tested on the Queensland strains of tick fever at the Animal Health Station, Yeerongpilly.

The drug is put up in tablet form, each tablet weighing 0·25 grams, which is the dose for a small animal. It is also obtainable in a liquid form, being prepared in sealed ampoules each containing 6 c.c. of a 5 per cent. solution, which is the dose for an average-sized cow. The liquid form of the drug, which has the trade name of Acaprin, is undoubtedly the most convenient for the farmer, who in cases of emergency is frequently called upon to treat cases of redwater without the aid of expert veterinary advice. When Acaprin is used all that is necessary is to break the neck off the ampoule, draw the liquid into a clean syringe, and then inject it under the skin of the sick animal, whereas when the tablet form is employed water has to be sterilised by boiling, allowed to cool to blood heat, and then one or two tablets are

dissolved in 5 to 10 cc. of water, according to the size of the animal to be treated. When this is done the dose is injected under the skin as with Acaprin.

The Treatment of Piroplasmosis with Aciron.

Several experimental cases of piroplasmosis have been treated at the Animal Health Station, Yeerongpilly, with Aciron. The results obtained have been most satisfactory, and suggest that the drug is equally as effective as piroblue in the treatment of this type of tick fever. Within twenty-four hours of treatment there has always been a marked improvement in the general condition of the animal, the temperature has come down considerably, in most cases returning to normal, and the organisms have become markedly diminished or have completely disappeared from the circulating blood. In those cases in which redwater was present the urine had returned to its normal colour overnight. In one case a large dose of the drug killed out the organisms completely from the animal, so that it was unable to transmit the disease; however, it still retained its immunity and proved resistant to reinfection fifty days later.

Treatment of Babesiellosis with Aciron.

Prior to the advent of Aciron no satisfactory drug was available for the successful treatment of this type of tick fever, consequently the results of this experiment were awaited with considerable interest. In order to carry out the experiment aged cows of a susceptible type were obtained from clean country and transported to the Animal Health Station, where they were infected with and developed babesiellosis. Different animals were treated with Aciron at various stages of the disease, and the results in all cases were very satisfactory. In one case in which treatment was carried out in a late stage of the disease a second treatment approximately twenty-four hours after the first was necessary before improvement and signs of recovery became evident.

As a general rule the animals were much improved on the morning following the treatment, and their temperatures were much lower. The organisms do not disappear from the blood following Aciron treatment in this disease as they do in piroplasmosis, and they may still be present several days later.

In addition to the cases treated at the Animal Health Station, Yeerongpilly, between thirty and forty cases of tick fever were treated in the field. A large proportion of these were definitely diagnosed as babesiellosis by the aid of microscopic slides, and the remainder were undiagnosed other than being types of redwater—i.e., either piroplasmosis or babesiellosis. All of these animals with the exception of one recovered following treatment. The animal that died was in a very advanced stage of the disease when treatment was carried out, and little hope was held out for its recovery.

Both the liquid and tablet forms of the drug were employed in obtaining the above results, and in all cases the dose was from 5 to 10 c.c. of a 5 per cent. solution given subcutaneously—i.e., under the skin. The method of using the drug is similar to that of inoculating cattle with blood for tick fever. The site of injection is not important provided that the drug is delivered under the skin, although perhaps the most convenient place is behind the shoulder. Aciron should *not* be given into the jugular vein, as is necessary with piroblue. It has been stated that occasionally alarming symptoms such as salivation,

muscular tremors, &c., may follow within half an hour of the use of Aciron, but they can be controlled by an injection of up to 10 c.c. of another drug known as Rephrin. However, in all cases treated with the normal dosage under our control no such symptoms have developed.

It should be thoroughly understood that the earlier treatment is carried out the greater will be the chances of recovery. When the disease is suspected the animal's temperature should be taken by means of a thermometer, and if it is in the vicinity of 105 deg. treatment should be carried out without delay. The temperature should be taken regularly three or four times per day, and if it has not dropped to under 104 deg. in twenty-four hours the treatment should be repeated. Owners should not wait until red urine is passed, for then the animal is in an advanced stage of the disease and treatment is more difficult.

In addition to the above treatment, it is essential to ensure that the animals are comfortably housed, where practicable, and the appetite should be tempted with palatable food such as bran mashes and green stuff given in small quantities at frequent intervals. Where there is any evidence of constipation an opening drench should be administered.

In view of the difficulty in arriving at a correct diagnosis of the type of tick fever with which an animal may be affected, owners are advised to treat all suspected cases with Aciron or preferably the liquid form, Acaprin. This drug is recommended because, besides being a specific against piroplasmosis, it is the only drug that has given good results in the treatment of babesiellosis, by far the most common form of tick fever encountered in natural cases in Southern Queensland. The dose rate is comparatively small, being from 5 to 10 c.c., and the method of administration is simple and can be carried out by any person who has a suitable syringe and needle.

WORLD'S CHAMPION COW.

It was stated in "The Australasian" recently that for the first time in thirty years the world's record for milk and butter-fat production are both held by one cow, Carnation Ormsby Butter King, a Holstein, owned in the United States of America. Several correspondents have written to that journal stating that this cannot be correct, as the Australian Illawarra Shorthorn cow Melba 15th of Darbalara produced a greater quantity of butter-fat. The claim made for the American cow is a record for both milk and butter-fat production in the one lactation, and not for milk or butter-fat production. Her figures are 38,606 lb. milk and 1,402 lb. butter-fat, while those of Melba 15th of Darbalara are 32,522½ lb. milk and 1,614.10 lb. butter-fat. In both cases the tests are for 365 days. Although Carnation Ormsby Butter King produced 6,083½ lb. more milk than Melba 15th, her yield of butter-fat was 212.10 lb. less. It is, however, not improbable that Carnation Ormsby Butter King has justified her right to hold the world's record for simultaneous milk and butter-fat production.

The occasion is fitting to give the complete record of Melba 15th of Darbalara, which was one of the greatest producers in the world. Junior two-year-old, 1918—milk 8,844 lb., average test 4.5, butter-fat 395.07 lb. in 273 days. Senior three-year-old, 1919—milk 13,510.50 lb., average test 4.3, butter-fat 587.13 lb. in 273 days. Senior four-year-old, 1920—milk 21,635.5 lb., average test 4.4, butter-fat 954.47 lb. in 365 days. Mature, 1922—milk 29,432 lb., average test 4.5, butter-fat 1,316.81 lb. in 365 days. Mature, 1923—milk 32,522.50 lb., average test 5.0, butter-fat, 1,614.10 lb. in 365 days. Her average for the five tests was:—Milk 21,188.90 lb., butter-fat 973.51 lb.

Principles of Botany for Queensland Farmers.

C. T. WHITE, F.L.S., Government Botanist.

INTRODUCTION.

IN connection with the appointment of inspectors under the Diseases in Plants Act, it has been deemed advisable that the appointees should have some knowledge of the principles of botany. In discussing the matter with the Editor, he suggested that a series of articles should be published through the "Queensland Agricultural Journal," and afterwards issued in book form. Most of the existing text-books deal with the subject of botany in rather too detailed a form for the requirements of the officers concerned, and the Editor thought that it would be possible to publish articles that would be of general interest to the farming community. Parts of the book have been taken from my "Elementary Text-book of Australian Forest Botany," and for the right to reproduce some of the text and many of the illustrations I am indebted to the Commissioner of Forests of New South Wales, Mr. E. H. F. Swain.

I would like to offer to those interested in plants a few words of advice as to the best means of pursuing botanical studies so that they can make most use of them. For the purpose of getting to know the native or commonly cultivated plants, specimens should be gathered and an endeavour made to trace them down by means of a flora. If this is found to be too laborious the specimens should be sent to a State Government Botanist for identification. When the determinations have been received the "flora" should be consulted and the description run over. It is also a good plan to run over the descriptions of the genus and family or order as well. For this work "The Queensland Flora," published by the late F. M. Bailey, in six volumes, will be found necessary for the serious student. In collecting specimens for identification a shoot about 9 inches long and bearing leaves and either flowers or fruits should be gathered. If both flowers and fruits can be obtained, so much the better. Of grasses and small herbs the whole plant can be gathered. It is a good plan to send the whole stem of a grass doubled backwards and forwards so as to fold comfortably in a small sheet of newspaper, and to include several additional seed heads. Of larger herbs it is advisable to send the lower growth so as to show the characteristic leaves of the lower part of the plant, which often differ markedly from those at the top. Plants are more easily worked out or determined when fresh than when dried. A hand lens magnifying from five to ten diameters should be obtained for examining small plants and for critically examining those with a more intricate floral structure. It is obviously impossible to send specimens away any distance in a fresh condition, and in sending specimens for identification a flowering or fruiting shoot should be gathered, pressed flat between sheets of newspaper, and the newspaper changed every day or so till the specimens are dried; several thicknesses should be placed between each specimen. The specimens should be numbered and a duplicate retained. Fleshy fruits and large woody seed vessels should be dried separately. Field notes on the nature of the bark, size of the tree, &c., are of great assistance for determination purposes, and in some Australian trees, such as the Eucalypts and Angophoras, are almost indispensable to correct identification.

Botany is one of the most fascinating and at the same time useful of the natural sciences, a little knowledge of which makes every place of interest, and if the present work in addition to supplying the need of plant inspectors helps only a few people towards a study and proper appreciation of our native plants, it will have fulfilled the desire of the author.

CHAPTER I.

General.

Botany is that branch of natural history which deals with plants, and has for its object the study of their life histories, structure, distribution, classification, economic uses, and general properties.

It is one of the two branches of the great science biology, which embraces the study of all organisms or living objects as distinct from such lifeless objects as rocks and minerals. Zoology, the other division of biology, deals with animals.

The following are some of the chief characters and properties of plants, the definitions, however, being only broadly true, as it is impossible to lay down regular definitions when writing on natural history.

Plants are generally stationary, and have a prevailing green colour, due to the colouring matter chlorophyll.

The living substance of the plant secretes cellulose, which forms the cell walls, and which is, practically speaking, absent from the animal kingdom.

A plant is able to receive nourishment direct from inorganic matter. The large groups, fungi and bacteria, are exceptional as they contain no chlorophyll, and are largely parasitic—i.e., living on and at the expense of other organisms; or saprophytic—i.e., living on decaying organic material.

Notes on General Classification.

Before making a study of the plant and its parts in detail it would be well to acquaint ourselves with the general scheme of plant classification as now in use, and perhaps the following example will serve to explain the main ideas.

The Stringybarks, the Tallow-wood, the Blue Gum, the Flooded Gum, the Bloodwood, and the Ironbarks, though distinct from one another, will be seen to have certain points of similarity. In the words of the systematist, they are all species of a single genus.

According to the binomial system of nomenclature introduced by the great Swedish naturalist, Carl von Linne (better known as Linnaeus), every plant has two names—the generic and the specific—both of which should denote some distinguishing feature of the plant, and which correspond to a personal surname and christian name respectively.

Thus we have the White Stringybark (*Eucalyptus eugenioides*), the Yellow Stringybark (*E. acmenioides*), the Bloodwood (*E. corymbosa*), and so on.

We can easily see that the Apple Trees (*Angophora*), the Scrub Box (*Tristania conferta*), and the Turpentine (*Syncarpia*) are closely allied to the Eucalypts, but differ from them more than one eucalypt differs from another. This is expressed by saying that they belong to different genera of a single Natural Order or Family.

The possession of the embryos of the plants mentioned of two opposite seed-leaves or cotyledons places them in the group Dicotyledons, which includes most of our forest trees.

In most flowering plants the ovule, or young seed, is enclosed in an ovary, and they are termed Angiosperms, which great group includes practically all our cultivated vegetables, fruits, &c., and most of our native forest trees, with the exception of the Conifers, which, having a naked ovule or seed, are called Gymnosperms.

The Angiosperms and Gymnosperms together constitute the Phanerogams, which include all plants forming true seeds. Thus we have—

The Vegetable Kingdom.

Sub-kingdom Phanerogamae or Phanerogamia.

Division Angiospermae.

Class Dicotyledonae.

Family or Natural Order Myrtaceae.

Genus Eucalyptus.

Species E. acmenioides.

After this we have sub-species, varieties, and forms, as will be found explained in the chapters devoted to classification.

After the name of the genus or species we often find placed certain initials or names. These denote by whom the plant was so designated. Thus *Eucalyptus* L'Herit., means that the genus Eucalyptus was first defined by the French botanist L'Heritier, and *E. acmenioides* Schauer means that this species was first defined by the German botanist Schauer. Though seldom used, the authority following the specific name is, strictly speaking, just as much a part of the name of the plant as the genus or species. The authority is generally dropped in books of a popular nature, but is nearly always to be found appended in articles of a technical nature, and in "Floras," as the systematic and descriptive account of the vegetation of any country or district is called, as Bentham and Mueller's "Flora Australiensis," Bailey's "Queensland Flora," &c.

It will commonly be noticed in the following pages that the letters sp. or spp. are often placed after the name of a genus. These abbreviations are used when it is not desired or deemed necessary to particularise any one species of the genus referred to. Sp. implies species in the single sense, spp. in the plural. Thus in the next chapter, when referring to adventitious roots, *Ficus* spp. are given as examples; here it is meant that many species of our native figs form these adventitious roots (*Ficus macrophylla, F. platypoda, F. Watkinsiana,* &c.). It will also be noted that when listing different plants of the one genus, it is not necessary to keep repeating the generic name in full; this can be abbreviated by using the initial letter of the generic name.

In the following pages, Chapters II. to VIII. deal with morphology or the study of the form and external appearance of the plant, Chapters IX. to XI. with the anatomy or internal structure of the plant's organs, and Chapters XII. to XVII. with physiology or the study of the various life processes of the plant, particularly with the two great factors of nutrition and reproduction. These are followed by chapters on classification and systematic botany, and geographical botany and plant distribution.

CHAPTER II.

The Root.

The root may be typically defined as the descending portion of the plant. It has neither leaves nor buds, and is, practically speaking, always protected at the growing point by a layer of tissue known as the root-cap. (Plate 78.) There are a few exceptions to the latter part of this rule—e.g., the primary root of the Dodder (*Cuscuta*) and some other parasitic plants has no root-cap.

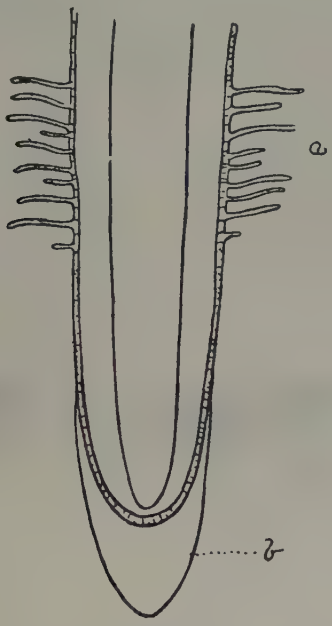


Plate 78.

Longitudinal section of tip of growing root (diagrammatic), much enlarged; *a*, root-hairs arising as outgrowths of epidermal cells; *b*, root-cap.

[The outer layers of the root-cap are continually being worn away by friction with the soil, but are rapidly replaced by fresh layers from within.]

A characteristic of most roots is the possession of root-hairs which are developed from the epidermal cells close behind the growing point. Only a small part of the root is clothed with them, for as the newer ones are formed the older ones die off. They greatly increase the absorption surface of the roots from which they spring. The roots of some plants, many aquatic species and some small-leaved conifers, for example, are unprovided with root-hairs. The character of the soil largely affects the production of root-hairs, and in certain crops it has been found that their development is retarded either in very wet or very dry soils, their greatest development being in moderately damp soils.

The chief functions of the root are—

(*a*) To anchor the plant firmly in the earth.

(*b*) To help maintain the life of the plant by absorbing water and nutritive substances held in solution in the soil.



Plate 79.

Pandanus on sea-shore, Green Island, near Cairns, showing prop roots.

[*Photo. by Queensland Government Tourist Bureau.*

They may also take on special functions, such as climbing organs (as in the Creeping Fig, the Ivy, &c.), as reservoirs or storehouses of nourishment (as in the radish, carrot, beet, turnip, dahlia, &c.), as props to keep the plant in position, as in *Pandanus* (Screw Pine) (Plate 79), in the Red Mangrove (*Rhizophora mucronata*), and on a smaller scale in the maize and other large grasses. In floating aquatic plants, such as the Water Hyacinth and Duck Weed, they act as a keel or ballast to keep the leaves and other floating parts in position.

The first root developed by any plant is termed the primary root. All roots subsequently developed from the primary root or any other part of the plant are termed secondary roots.

If we examine a young seedling tree we will usually find—

(*a*) A root growing straight down into the soil; this is the first root formed by the seedling, and is the primary root. In most cases this grows rapidly, elongates, and forms the tap-root of the older plant.

(*b*) Roots given off laterally from the main descending root, and branching and rebranching, these being termed the secondary roots.

New roots, when developed so that the youngest are always nearest to the growing point are said to be developed in acropetal succession,

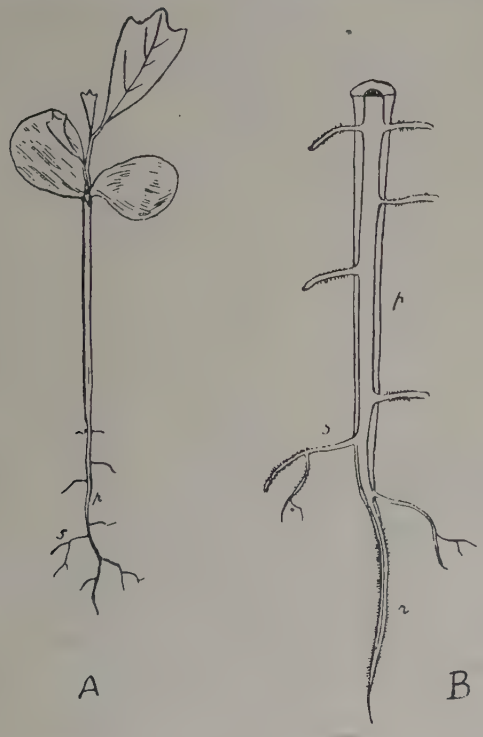


Plate 80.

A. Seedling, Wheel of Fire (*Stenocarpus sinuatus*), natural size.

B.—Longitudinal section of root (enlarged), somewhat diagrammatic, showing endogenous origin of the secondary roots; *p*, primary root; *s*, secondary roots; *r*, root hairs.

and are termed normal. All roots developed otherwise are said to be adventitious. The total root growth made by a plant is termed its root system.

All roots, except the primary root or roots, are formed from the inner tissues of the parent root or other member from which they originate, and as they grow break through the outer tissues. (Plate 80.)

In many plants the tap-root dies off, and an extensive adventitious root system is formed, numerous roots springing out from the base of the stem at successively higher and higher points; these, although they often arise from the stem at some distance above the surface of the soil, eventually travel down until they reach the earth and help to anchor the plant more firmly in the soil. This is well illustrated in the maize and other large grasses such as maize, sorghum, sugar cane, &c.



Plate 81.

Seedling Summer Grass (*Panicum sanguinale*), natural size; showing a primary root (*p*); this soon dies away, but the adventitious roots (*a*) continue to develop and fresh ones to be formed.

In many cases the whole root system is formed of these adventitious roots. Such a system is characteristic of the Monocotyledons (grasses, palms, lilies, &c.), although it is by no means confirmed to them, being found in many Dicotyledons. In the Monocotyledons, the embryo, or young plant, may possess more than one primary root. These are, however, only used by the growing plant in its very young stages, their place soon being taken by roots springing out from the lower parts of the stem. (Plate 81.)

Adventitious roots are usually fibrous, as in the grasses, but sometimes they act as storehouses for nutriment, as in the dahlia, sweet potato, and some Australian vines of the grape family, yam family,

&c. Roots, tuberous or otherwise, which become swollen and act as storehouses of nourishment, are termed tuberous roots or root-tubers.

Although true roots bear neither buds nor leaves, the roots of some trees are capable, under certain circumstances, of sending up leafy shoots termed root-suckers. These are specially characteristic of trees with a wide-spreading and shallow root system. Root-suckers are most frequently formed after injury to the parent tree, as when it has been cut down or severely cut back or pruned. The character is especially well developed in the Poplars, in the Tree of Heaven (*Ailanthus glandulosa*), in the English Elm, and in certain varieties of pears and plums.

In nursery work the formation of root-suckers is sometimes taken advantage of, as in the propagation by means of root-cuttings of the well-known horticultural plants *Dracæna* and *Cordyline* spp., of the horse-radish, blackberry, &c.

These root-suckers are not to be confused with the stool shoots or coppice shoots of ecualypts and other trees to which the term sucker shoots and sucker leaves are popularly applied. Stool or coppice shoots spring from the main trunk mostly after it has been injured, and especially from the butt or stump after the main trunk has been cut down.

With the object of making a dense, bushy head, it is a common practice to cut off the trunk of a tree some 6 feet or more above the ground. The shoots that spring from just below the cut surface are termed pollard shoots to distinguish them from ordinary stool shoots which arise from a low stump. The practice of pollarding is often resorted to by gardeners to improve the symmetry of and appearance of Eucalypts and other trees which do not ordinarily bear dense foliage. It is seen in commercial practice where willows are topped or pollarded for the purpose of producing numerous shoots suitable for basket-making.

Tropical and subtropical mixed forests contain a number of trees whose uppermost roots and basal portion of the trunk form large plank-buttresses. In the rain-forests of tropical and sub-tropical Australia this habit is well developed in many species; for instance, in the different species of Figs (*Ficus* spp.), Stavewoods or Crowsfoot Elms (*Tarrietia* spp.) (Plate 82), the Carrabin (*Sloanea Woolsii*), the Marara (*Weinmannia lachnocarpa*), &c.

In rain forests or heavy jungles, in Queensland misnamed "scrubs," the absence of much direct sunlight on the ground surface and the fertility of the humus-containing upper layers of the soil both tend to develop surface roots; owing to the high humus content of the surface soil and its avidity for oxygen, oxygenation of the subsoil is retarded, and this acts still further to develop extensive surface root systems, often including large plank-buttresses.

The old, hard, woody roots and root buttresses probably serve the very useful purpose of stays, helping the tree to resist the lever-like strain exerted by the stem with its crown of branches and foliage as it is swayed by the high winds. Increased resistance to wind is rendered necessary in the rain forests, because the saturation of the soil by the excessive rainfall increases the liability to windfall.

When roots are developed in the earth they are termed subterranean, when in water aquatic, when in the air aerial. Some aerial roots—as in many Figs (*Ficus* spp.), are formed on the main branches and travel

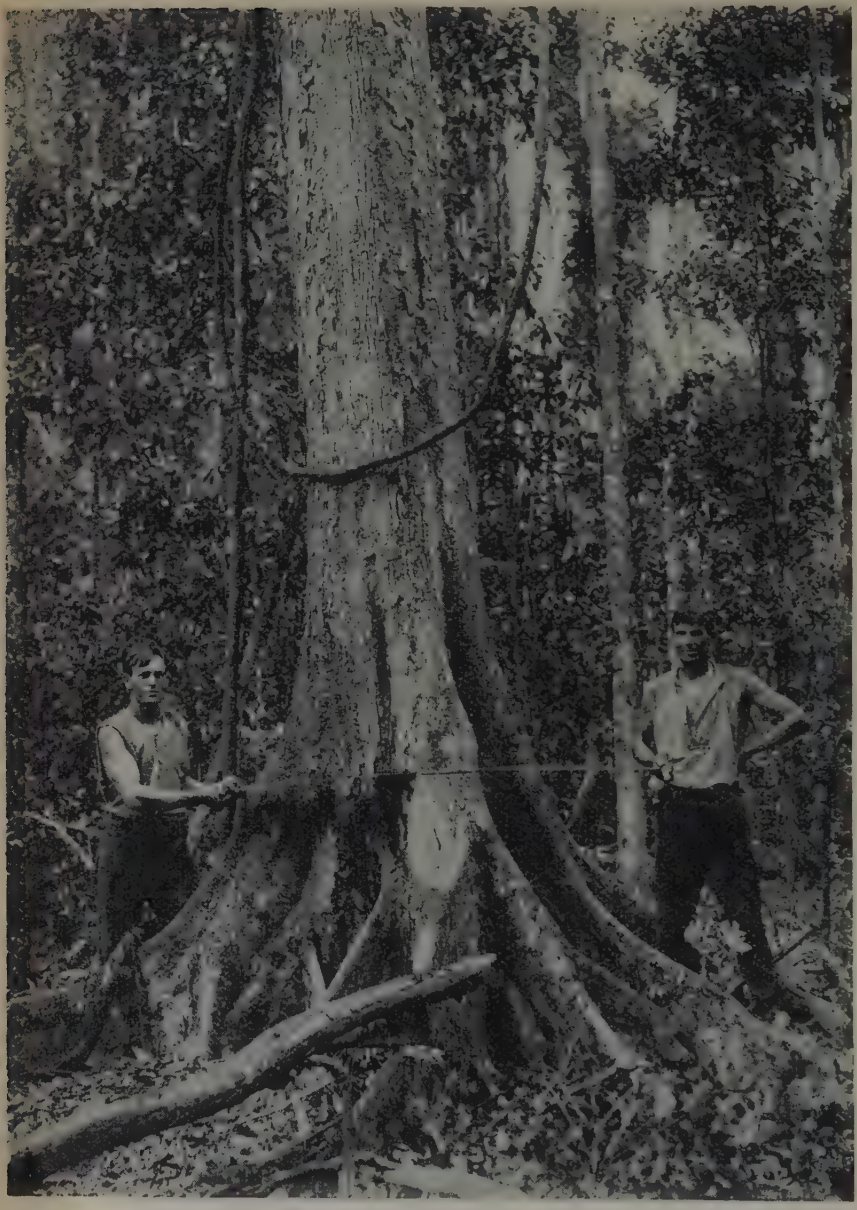


Plate 82.

Crow's-foot Elm or Booyong (*Tarrietia argyrodendron*), showing typical buttresses, Imbil State Forest, Mary Valley.

[*Photo. by A. H. Chisholm.*

down till they reach the earth, and help to support the member from which they originate, besides supplying the tree with additional nourishment. In this way a single tree may eventually cover several acres, as in the well-known Banyan type of fig-trees. In the majority of figs the whole trunk is often formed from aerial roots (Plate 83).

In many mangroves the aerial roots developed from the stem form stilt-like processes which serve not only to fix the tree firmly in the soft, muddy substratum in which these plants grow, but also to ensure a supply of oxygen for the rest of the root system. In the Black Mangrove (Plate 84), found along the whole Queensland coast, in the White Mangrove (*Avicennia*), in one form or another one of the most widely distributed of trees round the coasts of the world, and in some other mangroves and swamp trees, the roots send up breathing processes or aerating roots which serve to give the plant additional communication with the atmosphere, and thus ensure a sufficient supply of oxygen for the roots, there being no supply of free oxygen in the mud in which these trees grow. New roots are formed below the processes, and these serve to prevent the mud being washed away from the root system and to keep a new root system always in conformity to the mud level. Some aerial roots, those of epiphytes, plants which live on trees but are not parasitic on them—very many orchids, for example, do not reach the ground, but mainly serve as means of attachment; they frequently contain chlorophyll, the green colouring matter of plants, and perform in part the functions of leaves.

The roots of epiphytic orchids are enclosed in a spongy sheath, termed the velamen. It is the velamen which gives the white, corky appearance to orchid roots, especially when dry. It is a many-layered, spongy tissue, whose function it is to soak up rapidly and afterwards hold moisture. A similar sheath is developed in the epiphytic members of another family of plants, the aroids or *Araceæ*.

CHAPTER III.

The Stem.

In its typical form the stem may be defined as the ascending leaf-bearing portion of the plant.

The first stem formed by a seedling is termed the primary stem. All stems, with the exception of the primary stem, are developed from the superficial tissues of the member from which they originate, and not from the internal tissues as are roots.

The forms taken by stems are of infinite variety, some trailing along the surface of the soil, some slender and climbing, and some extending underground, when they can only be distinguished from roots by the absence of a root-cap and the presence of scale-like leaves or the possession of leaf-buds.

In plants of annual duration the stems are usually somewhat succulent in texture, and are said to be herbaceous.

When the primary stem persists for some years, as in trees, it becomes hard and woody, and is termed the trunk.

Nodes and Internodes.—The point at which one or more leaves is given off is termed a node, and the portion of stem lying between two successive nodes an internode. In many plants the nodes are swollen

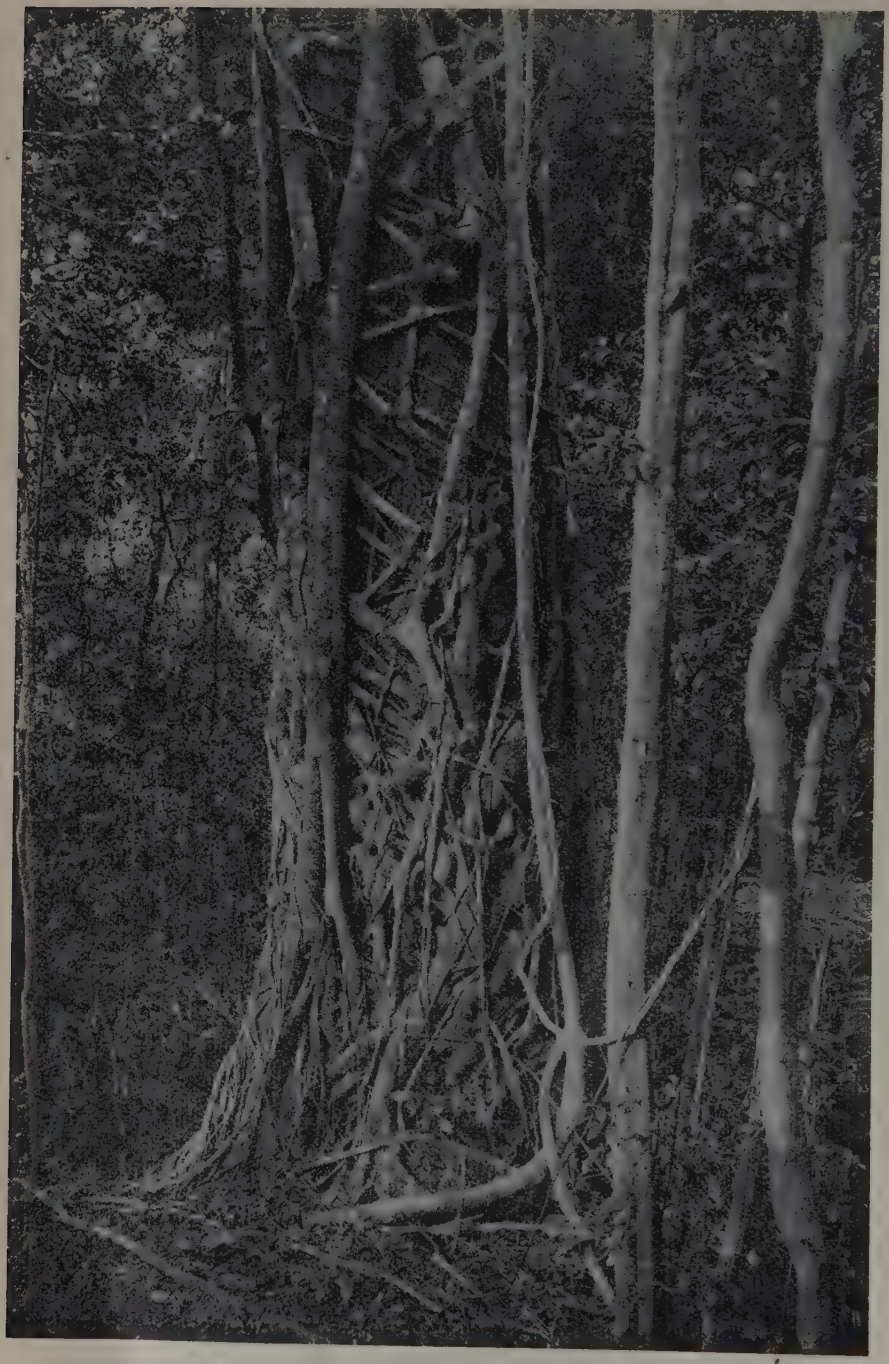


Plate 83.

Roots of a Native Fig (*Ficus Watkinsiana*), Lamington National Park, South-Eastern Queensland. The roots are gradually crushing the life out of the host tree, and will eventually feed on the decaying wood. The whole trunk of the fig tree will thus eventually be formed of root tissue.

[*Photo. by Queensland Government Tourist Bureau.*

or marked by a well-developed line around the stem. This is well seen in grasses, especially in the bigger sorts, such as the bamboos, sugar-cane, maize, &c.

General Descriptive Terms.

When stems are seen to be circular in transverse section they are said to be cylindrical, when possessing several prominent angles to be angular, when marked longitudinally with more or less prominent ribs to be costate or ribbed, or they may be furrowed or striate if the furrows are small and line-like, and so on.



Plate 84.

Black Mangrove (*Bruguiera Rheedei*), showing mangrove knees. Russell Island, Moreton Bay.

[*Photo. by C. T. White.*

Commonly stems or branchlets are angular in a young state, becoming more or less cylindrical with age, as the young branchlets of Queensland Black Wattle (*Acacia Cunninghamii*), the young coppice stems of some eucalypts, &c.

Climbing Plants.—The forms assumed by climbing stems and the special organs adapted for climbing are various. They may cling by means of adventitious roots, as in the Ivy and Tecoma radicians, by means of special organs called tendrils, which are slender, thread-like bodies, simple or branched, and which twine in a loose or tight coil round some stronger-stemmed plant or other support. They may be specially modified branches, as the cucumber, melon, passion vine, grape vine, &c.; modified parts of the flowering branches, as in *Antigonon*. In some species of *Ampelopsis* (Virginian Creepers) the tendrils form

flat, adhesive discs at their tips. Some climb by means of hooks and recurved spines, as in the Lawyer Vines (*Calamus* spp.). When a plant climbs by spirally twisting round a support it is termed a twiner, as in the Morning Glory.



Plate 85.
Lianes in a tropical rain-forest or scrub, Malanda, North Queensland.

[*Photo. by Queensland Government Tourist Bureau.*

Some plants, though not distinctly climbers, may often be found with their stems resting on or entangled among the branches of stronger-growing plants, and are said to be rambling or straggling, as in the well-known garden plant Bougainvillea. When growing in the open such plants take the form of rambling shrubs, but when growing in the mixed, dense forest often climb to a considerable height among the tops of the trees, as in the Cockspur Thorn (*Cudrania*), and Lantana (*Lantana Camara*).



Plate 86.

Nut Grass (*Cyperus rotundus*), a plant with underground runners or stolons.

[*Photo., Department of Agriculture and Stock, Brisbane.*

A large climber with a woody stem is called a liane, as the Water Vines and Monkey Vine or Monkey Ropes of the coastal scrubs or jungles. (Plate 85.)

In some plants the stem presents a jointed appearance at the node, the stem being hollow between the points, as in grasses. In this case the stem is termed a culm.

A stem rising from the ground and bearing flowers, but no green leaves, is termed a scape—e.g., the Spear Lily (*Doryanthes*), the ground orchid (*Dipodium punctatum*), Flat Weed (*Hypochœris radicata*) Dandelion, &c.

Runner or stolon is the term applied to branches which travel some distance, reaching the ground at intervals, and forming buds from the base of which adventitious roots are formed. These buds eventually form independent plants owing to the portion of the stem between them and the parent plant dying away. They may be aerial, as in the strawberry, Rhodes grass, water hyacinth, &c., or subterranean, as in the potato, nut grass &c. Plants which produce a number of stolons are said to be stoloniferous. (Plate 86.) When runners are short and stout, as in some garden succulents, they are often termed offsets.

This method of propagation is often artificially induced in different plants by gardeners by taking the branches and pinning them down to the soil where, when they have sent out sufficient adventitious roots, they are separated from the parent plant, the process being termed layering.

A rhizome is a root-resembling stem more or less subterranean and horizontal, giving off numerous fibrous roots below and leafy shoots above—e.g., Cunjevoi, many grasses and sedges, as Couch grass, Johnson grass (Plate 87), &c., many ferns, as Bracken, &c. Shoots arising from subterranean branches are termed suckers—e.g., common garden Mint. When arising from roots such shoots are termed root-suckers.

A corm is a short, fleshy, underground shoot consisting for the most part of a massive, swollen, solid portion called the disc, which is covered externally by a few more or less sheathing, scaly, inconspicuous leaves, as in Gladiolus, Watsonia, &c.

A bulb is a short, stout, underground stem, but the disc is comparatively small, being covered with large, fleshy scales—e.g., onion, lily, &c. The corm is sometimes referred to as a "solid bulb."

A tuber is a swollen, underground stem, or portion of a stem, bearing scale-like leaves with buds in their axils from which leafy shoots arise, and by which they can be distinguished from roots. The tubers of the potato are borne at the end of subterranean runners or stolons.

Bulbils are small bulbs, corms, or tubers, which make their appearance on aerial shoots, separate from the parent plant, and on reaching the ground are capable of forming independent plants. They are found in many species of *Dioscorea* (Yams).

When branches are green and take on the functions of the ordinary green leaf they are termed cladodes or phylloclades, the most familiar examples in Australia being the various prickly-pears (*Opuntia* spp.). In these plants the flowers and fruits are borne on the edge and flat surface of the cladodes. The true leaves borne on the young shoots are quite small, and soon wither or drop off the cladode as it increases with age.



Plate 87.

Johnson Grass (*Sorghum halepense*), a grass with large white underground rhizomes.

[*Photo., Department of Agriculture and Stock, Brisbane.*

Cladodes are not always flat. In the She Oaks (*Casuarina*) the leaves are reduced to minute teeth, occurring in circles at intervals along the branches, which are green and perform all the functions that would ordinarily be fulfilled by the foliage leaf. In the Dogwood (*Jacksonia*) and Native Cherry (*Exocarpus*) the cladodes are slender and angled, the leaves are often seen on young trees and shoots, but are very deciduous.

The young stems and branchlets commonly bear characteristic marks often of much use as distinguishing characters—e.g., the leaf-scars, the points from which leaves have fallen often show up very prominently, and enable one to arrive at a knowledge of the leaf arrangement, though all the leaves have fallen.

Lenticels are external openings in the bark, and are special organs which allow the air to gain access to the internal tissues. They are usually noticeable as raised corky lines or spots of a paler colour than the surrounding bark.

Stem Structure.

If we make a transverse cut through the stem of any of our common forest trees or shrubs we will see that it consists of two distinct parts—a large, internal, hardened portion (the wood) and a thinner, softer, external portion (the bark). The latter is composed of two distinct portions, living tissue on the inside and dead tissue on the outside, and although the whole is commonly called bark, by many botanists that term is applied only to the exterior layer of dead tissue. As the stem of the tree expands the outer layer of dead bark, being unable to grow further, must be gradually shed or split, and the manner in which this takes place varies for different trees. In the Cherry and young Hoop Pine it peels off in rolls. In many gums, such as the Gum-topped Box, it is shed in long ribbons. In other trees, such as the Spotted Gum, the Plane Tree, and Kauri Pines, it falls off in flakes. Where it is more persistent it usually becomes cracked and fissured in some way; an extreme example is seen in the Ironbarks.

Heart-wood and Sap-wood.—In older trees the wood is often marked off into two distinct portions, an inner, the heart-wood or duramen, being darker, much harder, and more durable than an outer, the sap-wood or alburnum.

In many wattles (*Acacia*), particularly those of inland parts, such as the Mulga, Bendee, Boree, &c., and eucalypts the duramen is very dark and heavy, and occupies the greater portion of the stem, the alburnum being reduced to a narrow border of paler-coloured wood. In some of the woods of the tropical and subtropical mixed forests of Queensland and northern New South Wales distinctive hard and softwood zones may not be differentiated.

Annual Rings.—In many trees a transverse section of the stem shows a number of lines arranged around the pith, dividing the stem into successive concentric layers known as the annual rings, so called because, as a rule, one ring is formed each year, so that by counting the number of rings the age of the tree can be ascertained.

In plants of colder countries, where the seasons are well marked and growth is practically at a standstill during the winter, the annual rings are usually very pronounced, the cause being that wood formed in spring is of less density than that formed in the autumn or later in the year. The change from spring wood to autumn wood is frequently a gradual one, but the difference between the autumn wood of one year and the spring wood of the next year lying outside it is quite sharp.

In the majority of trees and plants of tropical countries the annual rings may be ill defined or even entirely absent. Two native trees in which the annual rings are particularly well defined and reliable are the Red Cedar and the White Cedar, which, being deciduous, have a well-marked period of rest.

Medullary Rays.—Running from the centre out towards the bark can generally be noticed a number of radiating strands known as medullary rays. The presence or absence of these rays, their relative size and prominence, distance apart, and other characters that can be noticed are important points in timber identification. Seen on a longitudinal radial section of the wood these rays appear as shining bands, more or less marked, giving the well-known silver grain to wood "cut on the quarter."

A section through a palm stem shows no medullary rays or annual rings, but shows up a number of hard, usually black areas, the vascular bundles.



Plate 88.

Transverse section through stem of a Tree Fern (*Alsophila excelsa*). The main vascular bundles are seen as eight large, curved bodies round the edge. Each is surrounded by a band of hard, strengthening tissue. The small black dots scattered over the centre are very small accessory vascular bundles.

[*Photo., Department of Agriculture and Stock, Brisbane.*

In a transverse section of a tree fern (Plate 88) these vascular bundles show up surrounded by large, elongated, black, hard areas: also no distinct bark is formed, the trunk, which in this case is really a very large, erect rhizome, being clothed with a mass of adventitious roots

and, usually, the bases of fallen fronds. The structure of the wood and bark is dealt with in more detail in the chapters devoted to anatomy.

CHAPTER IV.

The Leaf.

Leaves are lateral outgrowths from the stem from which, usually speaking, they differ considerably in form and structure.

Under leaves are included (*a*) the cotyledons or seed-leaves; (*b*) the foliage leaves, which are the ordinary green leaves of the plant and which in a popular sense are the only members regarded as leaves; (*c*) the scale-leaves, which are generally protecting organs to more tender parts and are often devoid of chlorophyll, and may be regarded in some cases as leaf-bases, the broad, green, spreading portion of which (the lamina or blade) has not developed, or as entire leaves which have remained in a rudimentary condition; they are usually found on subterranean stems, and may be thick and fleshy and serve as storehouses for food, as in the scales of an onion or lily bulb, or they may be protecting organs for the rudimentary and tender parts contained in the bud, in which case they are commonly brown and dry, but differ considerably in colour and texture in different species of plants. Some plants which are not green, produce, in addition to their flowering parts, scale leaves only; the root parasites *Orobanche* (Broom Rape) and *Balanophora* afford examples, as do some ground orchids—e.g., *Epipogum nutans, Gastrodia sesamoides, Dipodium punctatum,* &c.; (*d*) bracts and floral leaves, which will be dealt with in the chapters dealing with the inflorescence and the flower.

In the present chapter we will confine our attention to the foliage leaves; these are concerned with nutrition, being organs of respiration, and for converting the raw material absorbed by the plant into various compounds that can be utilised in the building up of its tissues.

Arrangement.—The mode of arrangement of the leaves on the stem as a general rule is constant in the same species of plant.

Two kinds of arrangement are recognised (*a*) spiral and (*b*) whorled. In the former only one leaf is developed at each node, and the leaves are said to be alternate; it is spoken of as the spiral arrangement because an imaginary line supposed to pass round the stem through the leaf-bases and following their order of development would describe a spiral.

In the whorled or cyclic arrangement two or more leaves are developed from the same node; when two leaves occur they are said to be opposite, as in Lantana, Coffee, Coleus, Salvia, Wild Mint, &c.; when three or more occur at the same node they are said to verticillate, as in some races of the Australian nut (*Macadamia ternifolia*), Oleander (*Nerium Oleander*), &c.

Sometimes the arrangement may vary on different branches or at different stages of growth, as in certain Eucalypts where the leaves on coppice shoots or young trees may be opposite, whereas on the ordinary shoots of the older trees they are alternate.

Opposite leaves are said to be superposed when they are arranged in two ranks; that is, in any one whorl the opposite leaves are in the same plane as those immediately above or below them, and their arrangement is said to be distichous or bifarious. In the majority of plants

with opposite leaves, however, the different pairs are generally placed at right angles to the immediate neighbouring ones, and are said to be decussate, though sometimes, as in the Apple Trees (*Angophora* spp.), by the twisting of the leaf-stalk and consequent alteration of the position of the blade the arrangement may appear distichous.

If in the same species of plant the leaves are opposite, sub-opposite, or even alternate, they are said to be scattered.

Leaf Axil.—The upper angle formed between the leaf-base and the stem or branchlets is termed the leaf axil.

Leaf Buds.—Buds may contain only rudimentary foliage leaves, or may develop into leaf-bearing and flowering shoots. When buds arise at the apex of the stem they are said to be terminal, when in a leaf axil axillary, while those formed in any other position are adventitious.

Buds may be covered with a series of dry scales which fall off as the bud opens and which act as a protection to the delicate, immature parts within—e.g., Brush Box (*Tristania conferta*); in some cases the young parts are protected by a coating of gum or resin, sometimes by a coating of wax, at other times by a covering of wool or hair. The various ways in which buds are protected can best be observed by gathering those of a number of easily accessible plants. Often the buds are unprotected by any of the means noted, when they are said to be naked.

Vernation.—The arrangement of leaves in the bud is termed vernation, and varies in different, but not in the same species.

The leaves in the bud stage may not be folded at all, as in Eucalypts;

May have the edges rolled inwards, i.e., when the edges of the leaf are rolled in on the upper surface towards the midrib, as in the Scrub or Brush Wilga (*Geijera salicifolia*);

May have the edges rolled outwards, or rolled in towards the midrib of the leaf on the under surface, as in the Brush or Scrub Stringybark (*Rhodamnia trinervia*);

May be rolled upon themselves so that one edge covers the other, as in the Figs (*Ficus* spp.);

May be coiled inwards from the apex, as in fern fronds;

May simply have the two longitudinal halves folded in face to face, the midrib acting as a hinge, as in the Red Ash (*Alphitonia*), Australian Nut (*Macadamia*); or

May be folded between the nerves in longitudinal or oblique pleats, as in the Cabbage-tree Palm (*Livistona*) and other Fan palms.

All these arrangements have different terms with which one becomes more or less familiar after some experience in descriptive botany.

Parts of a Leaf.—If a leaf be examined it will generally be seen that it consists of two distinct parts (Plate 89), (*a*) the expanded green portion, the lamina or blade, and (*b*) a more or less cylindrical stalk or petiole. In many plants the petiole is absent, in which case the leaf is said to be sessile, whereas a leaf with a distinct petiole is petiolate. Typically the petiole is of a cylindrical shape, but with the upper surface flattened and very often grooved or channelled, especially towards the base, serving to drain off water from the leaf-blade; it is sometimes

winged, as in the orange. Sometimes the base of the petiole is expanded into a sheath—the leaf-sheath or vagina—which partly or completely embraces the stem; this is well exemplified in most palms, in the Banana (*Musa* spp.), grasses, &c.

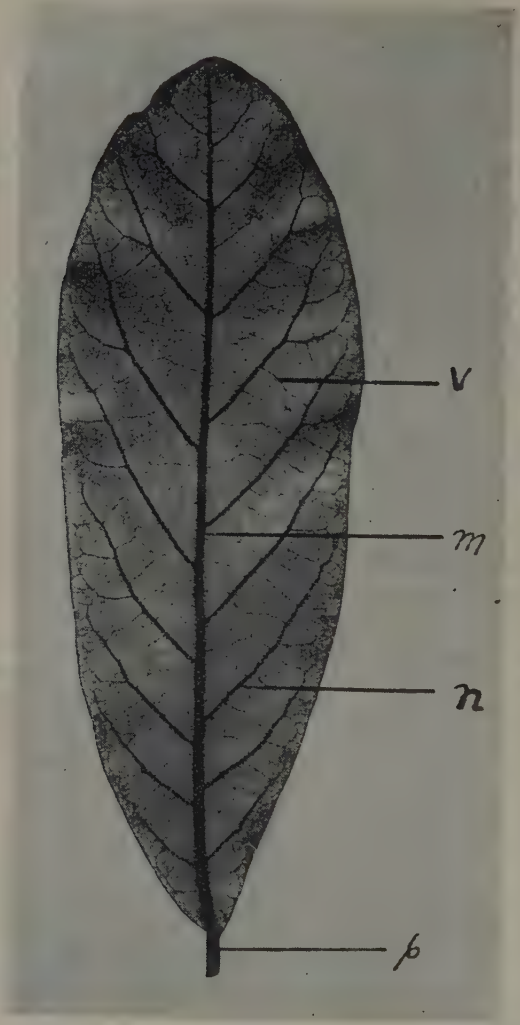


Plate 89.

Leaf of a Native Laurel (*Cryptocarya*). *m*, midrib; *n*, a main lateral nerve; *p*, petiole or leaf-stalk; *v*, veins and veinlets. The whole of the leaf apart from the petiole is called the lamina or blade.

Venation.—Looking at our leaf again, a continuation of the petiole will be noticed running up the centre of the leaf; this is termed the midrib (Plate 89 *m*), and given off from it on either side are a number of strands—the ribs, nerves, or veins (Plate 89 *n*)—and between these, again, a great number of smaller strands—the veinlets (Plate 89 *v*).

The manner in which the strands are arranged on the blade of the leaf is known as the venation, and varies considerably in different plants.

Two main forms are recognised:—

(*a*) Parallel veined leaves.

(*b*) Reticulate or net-veined leaves.

In parallel venation the stronger veins run parallel to one another, as in grasses, lilies, &c.

The term is also applied where there is a distinct central strand stronger than the others—the midrib—and veins running from it to the edge of the leaf and approximately parallel to one another, as in the Banana (*Musa* spp.), in Wild Ginger (*Alpinia* spp.), &c.

In both cases a number of veinlets connect the veins and run at right angles to them, but do not form a network, and are not sufficiently strong to prevent the leaf being torn in strips between the main nerves. Where there is a distinct main strand with lateral nerves given off every here and there either side of it the leaf is said to be penni-veined.

Generally speaking, as in Plate 89, the midrib divides the lamina of the leaf into two approximately equal longitudinal portions, but when the division is obviously unequal the leaf is said to be oblique, as in the Tree Tobacco (*Nicotiana glauca*).

Margin of the Leaf.—The margin of the leaf is said to be—

entire, when it is perfectly even and is not indented in any way;

serrate, when it shows a number of sharp, saw-like teeth directed upwards, as in the Wallum (*Banksia serrata* and *Banksia æmula*);

dentate, when the teeth are directed outwards;

crenate, when the teeth are rounded, as in several species of *Elæodendron;*

toothed, a term commonly used where perhaps the leaf cannot be described as distinctly serrate, dentate, &c., as the leaves of the Sassafras (*Doryphora*), which may be described as coarsely toothed;

sinuate, when deeply indented, with broad, irregular teeth, as in the British Oak (*Quercus Robur*);

spiny, when bearing a number of hard, spiny processes, as in the Holly (*Ilex*), in the Native Holly (*Alchornea*), &c.

Lobed or Divided Leaves (Plate 90). A penni-veined leaf may be lobed half-way down to the midrib or more, when it is said to be pinnatifid. If incised almost or quite to the midrib, as in the Silky Oak (*Grevillea robusta*), the Bangalow or Piccabeen Palm (*Archontophœnix*), the Burrawang or Zamia (*Macrozamia*), &c., it is said to be pinnatisect.

When there are several nerves radiating out from the base of the lamina the leaf is said to be palmately nerved, and the corresponding terms of palmatifid (Plate 90, figs. 4 and 5) and palmatisect (Plate 90, fig. 6) are used, according to the degree of lobing of the laminia; sometimes the leaf is simply said to be palmate or palmately divided.

The parts divided off by the incisions cannot be readily detached or pulled off without tearing from the midrib, and are called segments or lobes.



Plate 90.

Lobed Leaves.—1. White Yiel Yiel Leaf (*Grevillea Hilliana*), deeply pinnatifid. 2. Red Oak or Queensland Waratah (*Embothrium Wickhami* var. *pinnata*), pinnatisect. 3. Leaf from young tree of Silky Oak (*Grevillea robusta*) doubly or twice pinnatisect. 4. Scrub Bottle Tree (*Brachychiton discolor*), palmatifid. 5. Native Rosella (*Hibiscus heterophyllus*), deeply pinnatifid. 6. Bottle Tree (*Brachychiton rupestris*), palmatisect leaf from a young tree. The leaf on adult trees is usually different.

[*Photo., Department of Agriculture and Stock, Brisbane, from "Elementary Text-book of Australian Forest Botany."*

Sometimes the lobing is once or more repeated, as in young plants of the Silky Oak (*Grevillea*), species of *Petrophila* and *Isopogon*, when the leaf is simply described as pinnately divided, once or twice pinnately, palmately, or ternately divided, as the case may be.

Compound Leaves.—When, as in the case of Red Cedar, Rosewood, &c., the leaf is further divided so that each division has a distinct insertion of its own, and each of them can be separated from the common petiole, as the whole can be separated from the stem, the leaf is said to be compound, all other forms being known as simple. The divisions of a compound leaf are called leaflets. As with leaves, a leaflet may be sessile, nearly sessile, or provided with a leaf-stalk, the petiolule, when the leaf is said to be petiolulate.

The terms already given as to the margin, venation, &c., of a leaf can be applied in the same sense to a leaflet.

Shapes of Leaves (Plate 91).—The shapes of leaves are innumerable, but the following is a selection of terms employed in descriptive botany to the commonest forms of outline presented by the lamina of simple leaves. In the case of leaves with a cut margin the general shape is described by imagining a line passing through the base and apex of the lamina and passing through the outermost points of all the principal teeth or divisions of the lamina.

A leaf is described as—

acicular, needle-shaped, elongate, with sharp edges, and tapering to a point, as the Pine leaf (*Pinus* spp.). (Plate 91, fig. 1);

terete, elongate and round in cross-section, as the needle-leaved species of *Hakea* (Needle Woods or Needle Oaks). (Plate 91, fig 2);

linear, flattened and narrow, several times longer than broad, with parallel margins. (Plate 91, fig. 4);

subulate, narrow and tapering from base to apex, as the leaves in seedling trees of the Cypress Pine (*Callitris* spp.), Hoop Pine (*Araucaria Cunninghamii*). (Plate 91, fig. 6);

lanceolate, if elongate and tapering at both ends, as in Cabbage Gum (*Angophora lanceolata*). (Plate 91, fig. 7);

ovate, egg-shaped, with a broad rounded base and narrowed towards the apex, as in the coppice leaves of Spotted Gum and some other eucalypts. (Plate 91, fig. 17);

orbicular, circular or nearly so, as in the common garden Nasturtium (*Tropæulum majus*);

cuneate, wedge-shaped, broad and blunt at the apex and gradually tapering to the base, as in *Dodonæa cuneata.* (Plate 91, fig. 18);

triangular, the reverse to cuneate, broad at the base and gradually tapering to the apex;

spathulate or *spatulate,* shaped like a spatula, broad and rounded at the apex, long and narrow in the lower part, as the basal leaves of some herbaceous plants—e.g., the common Daisy, Flat Weed (*Hypochæris*), Cudweed (*Gnaphalium*), &c.

reniform, kidney-shaped, as in *Viola hederacea* (Native Creeping Violet);

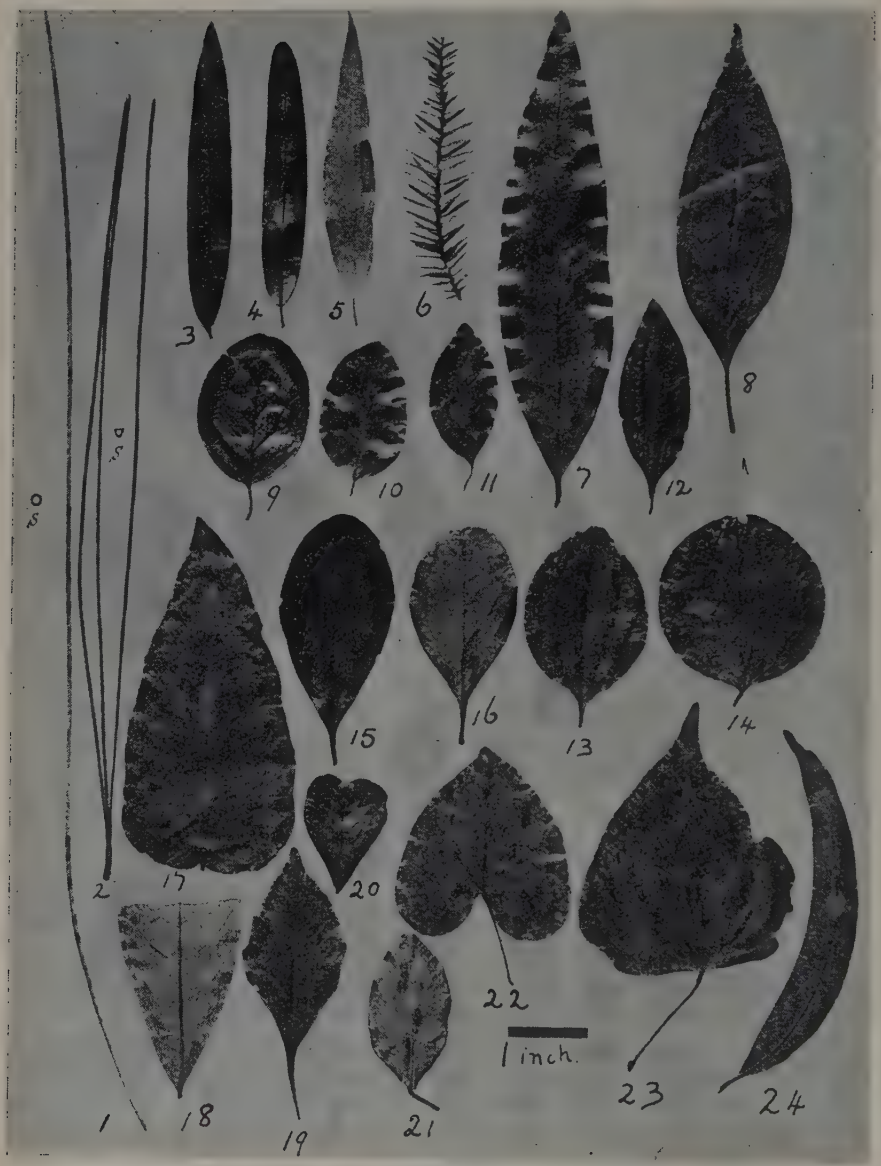


Plate 91.

Shapes of Leaves.—1. Cat-o'-nine-tails (*Hakea lorea*) (*s*) section (terete). 2. Pine (*Pinus*) (*s*) section (acicular). 3. She Pine or Brown Pine (*Podocarpus*) (linear-lanceolate). 4. *Hovea longifolia* (linear). 5. Cabbage Gum (lanceolate). 6. Hoop Pine Seedling (subulate). 7. Black Sassafras or Oliver's Bark (lanceolate). 8. *Litsea dealbata* (elliptic-lanceolate or broadly-lanceolate). 9, 10, 11. Quinine Berry (9 and 10 oblong, 11 elliptic). 12, 13, 14. *Exocarpus latifolia* (elliptic, oval, and orbicular, respectively). 15 and 16. River Mangrove (obovate). 17. Spotted Gum coppice leaf (ovate). 18. *Cupania Wadsworthi* (cuneate). 19. *Pittosporum rhombifolium* (rhomboid). 20. Scrub Leopard Wood off young branches (obcordate). 21. Scrub Leopard Wood off flowering shoot (oblong-elliptic). 22 and 23. *Barklya syringifolia* (cordate and deltoid, respectively). 24. Spotted Gum off flowering shoot (falcate). All the above leaves with the exception of No. 2 are from more or less common native Queensland plants.

[*Photo., Department of Agriculture and Stock, Brisbane, from "Elementary Text-book of Australian Forest Botany."*

falcate, sickle-shaped, as the leaves of many eucalypts, *Persoonia falcata,* the phyllodes of many wattles, &c.;

cordate, heart-shaped, with two broad, rounded lobes at the base and a gradually tapering apex, as in the Stinging Tree and Gympie Nettle (*Laportea*).



Plate 92.

Compound Leaves.—1. Simply pinnate, leaflets opposite (*Cassia*). 2. Simply pinnate, leaflets alternate (*Murraya*). 3. Trifoliolate (Coral tree, *Erythrina*). 4. Bi-pinnate (*Cæsalpinia*). 5. Digitate (*Heptapleurum*).

When following the descriptions of a plant in a "Flora," it is seen that many intermediate forms are described and the degree of variation in leaves in the same species taken notice of; thus we may have the leaves of a plant described as varying from "lanceolate to ovate-lanceolate or ovate," and we get such compounds as cordate-ovate, elliptic-oblong, and so on, to denote intermediate forms between those described above. A greater range of terms than given above is illustrated in Plate 91.

Apex of the Leaf.—The following are the descriptive terms applied to the apex of the leaf:—

acuminate, drawn out into a fairly long point, as in the leaf of the Deciduous Fig (*Ficus Cunninghamii*), which is abruptly acuminate, or in the leaves of the Bleeding Heart, *Homolanthus populifolius,* and most Eucalypts, which are gradually acuminate;

acute, distinctly pointed at the apex but the point not very prolonged, as in the leaves of many eucalypts (Plate 91, fig. 5);

obtuse, blunt or rounded (Plate 91, figs. 15 and 16);

truncate, terminating very abruptly as if a piece had been cut off, as in *Dodonæa cuneata,* a Native Hop Bush (Plate 91, fig. 18);

retuse, terminating with a rounded apex with a slight depression in the centre;

emarginate, blunt, with a distinct notch in the centre (Plate 91, fig. 20);

mucronate, blunt, with a sharp, stiff, projecting point in the centre, as in Red Mangrove (*Rhizophora mucronata*);

cuspidate, tapering gradually into a sharp, rigid point, as in the Bunya Pine.

Insertion of the Leaf.—Various terms are in use to describe the method of insertion on the stem, which varies considerably in different species of plants. The terms *petiolate* and *sessile* have already been explained.

With respect to the mode of attachment, leaves are—

peltate, when the petiole is fixed to some point of the leaf distinctly within the margin, as in *Tropæolum* (garden Nasturtium);

auriculate, when sessile with two rounded lobes at the base, as in the Milk Thistle or Sow Thistle (*Sonchus*);

decurrent, when the blade is continued down the stem so as to give the latter a winged or angled appearance, as in the native Cypress Pines (*Callitris*);

connate, when the bases of two opposite, sessile leaves are united together so that the stem passes through them, as in the upper leaves of some species of Honeysuckle or *Lonicera* (common garden plants).

Parts of a Compound Leaf (Plate 92).—The continuation of the petiole in a compound leaf which corresponds to the midrib of a simple leaf is called the *rhachis,* and when the leaflets are arranged along each side of it, the leaf is said to be *pinnate.*

When the leaflets are opposite and the rhachis ends in an odd leaflet, as in the rose, the leaf is said to be impari- or odd-pinnate, or when there is no odd leaflet at the apex it is said to pari- or abruptly pinnate, as in the leaves of different species of *Cassia* (Plate 92, fig. 1).

Often a compound leaf is described by the number of leaflets it possesses, and is said to be 2-, 3-, 4-*foliate,* and so on.

In many plants with compound leaves the leaflets are themselves completely divided in a pinnate manner, in which case the leaf is said to be *bi-pinnate* (Plate 92, fig. 4); the leaflets are called *pinnæ* and their segments or secondary leaflets *pinnules;* such cases are seen in the feather-leaved sorts of wattles (*Acacia decurrens, A. spectabilis, A. Baileyanan,* &c.), in the *Poinciana, Jacaranda,* different species of *Caesalpinia,* &c. If again these are completely incised, the leaf is said to be *tri-pinnate,* as is sometimes found in the White Cedar (*Melia*) and and in the fronds of some ferns.



Plate 93.

Heterophylly in coppice leaves (stump shoots) of Whalebone Tree or Axehandle Wood (*Pseudomorus Brunoniana*) (⅔ nat. size).

[*Photo. by A. G. Hamilton.*

In a palmately compound leaf the leaflets come off at one point, which in the case of stalked leaves is the apex of the common petiole. When a compound palmate leaf is composed of three leaflets it is said to be *ternate.*

A compound palmate leaf, as in the Black Jack (*Tarrietia actinophylla*), Umbrella Tree (*Brassaia actinophylla*), &c., with four or more leaflets is often described as *digitate* (Plate 92, fig. 5).

Generally speaking, beginners or persons not possessing any knowledge of botany look upon a leaflet of a compound leaf as a complete leaf, and the rhachis as a leaf-bearing stem.

Very often, in the same way, the simple leaves of certain plants are looked upon by beginners as leaflets of a compound leaf.

Many of the leaf-bearing branches of certain *Euphorbiaceæ* and other simple-leaved plants simulate pinnate leaves, the common creek-side tree *Glochidion Ferdinandi* furnishing an example.

If we examine a shoot of this tree we will notice—

(*a*) That small buds may often be found in the axils of the leaves—no bud is normally found in the axil of a leaflet or its rhachis.

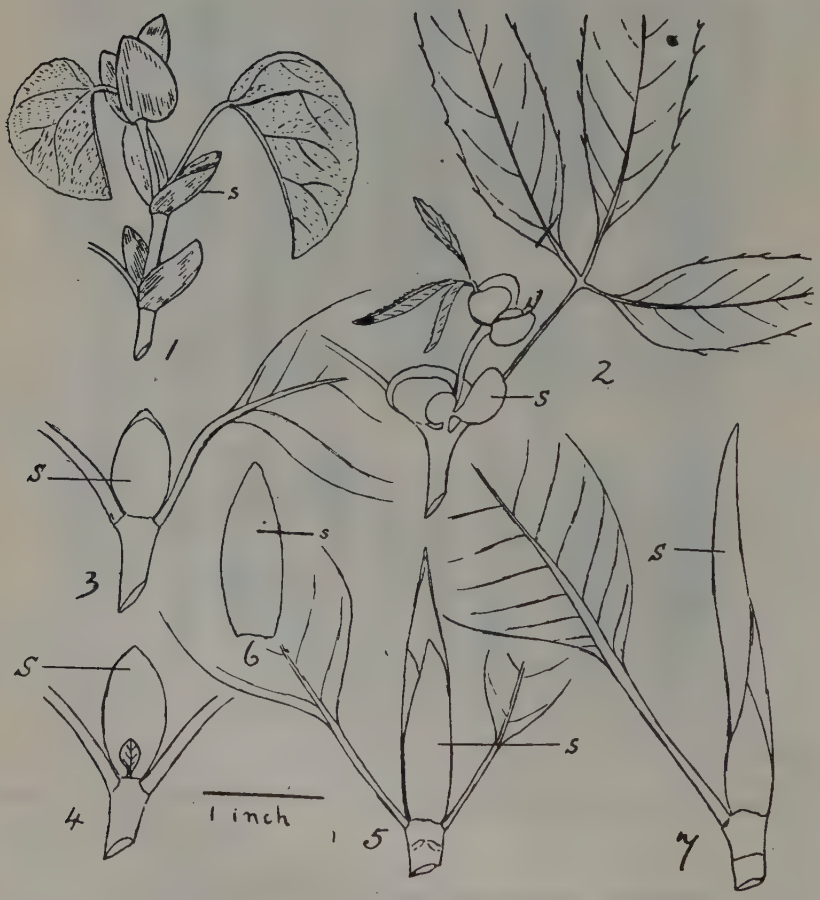


Plate 94.

Stipules (*s*) of some Eastern Australian Trees.—In the cases here figured the stipules are soon deciduous, being only found on the young branches, and their main function is to act as a protection to the young and growing bud.

1. Cotton Tree (*Hibiscus tiliaceus*). 2. Red Carrabin (*Geissois Benthami*). 3. Leichhardt Tree or Canary Wood (*Sarcocephalus*). 4. The same, one interpetiolar stipule removed to show the bud within. 5. Black Mangrove (*Bruguiera*). 6. The same, an enfolding stipule removed and flattened out to show the shape. 7. Moreton Bay Fig (*Ficus macrophylla*).

(*b*) Clusters of small flowers and fruits are found here and there along the shoot—no flowers or fruits are ever normally found on the petiole or leaf-rhachises.

(*c*) It may have an apical bud—no compound leaf normally bears an apical bud.

Some plants bear compound leaves composed of a single leaflet; the Orange furnishes a familiar example of what is called a *unifoliolate* leaf. It can be distinguished from a simple leaf by the fact that the expanded lamina is articulate on the winged petiole, which in this case is not continued as the midrib of the blade.

When leaves vary considerably in size and shape on the same plant they are said to be *polymorphic,* and the plant itself is said to be heterophyllous; *Hibiscus heterophyllus* (Native Rosella), *Solanum aviculare* (Kangaroo Apple), *Brachychiton acerifolium* (Flame Tree), many of our Proteaceae (Plate 93), &c., furnish examples of heterophylly in trees and shrubs. Where a plant bears leaves of two distinct types the leaves are said to be dimorphic; thus the leaves of seedling Hoop Pines, Cypress Pines, Moreton Bay Fig, Narrow-leaved Bottle Tree (Plate 90, fig. 6), and others, are very different from those in the adult trees, and the same is seen in the seedling and coppice growths of Eucalypts.

Most aquatic plants exhibit noted dimorphism, the submerged leaves and floating or ordinary exposed leaves, where both are present, often present marked differences. In some climbing plants the flowering and fruiting branches bear leaves markedly different from those of the barren branchlets; this is well seen in the Ivy (*Hedera Helix*) and the Creeping Fig (*Ficus pumila*).

The leaves of young plants are often larger than those of the mature growth. In the Wheel of Fire (*Stenocarpus sinuatus*), the leaves of young trees or of coppice shoots are large and pinnately divided, whereas in the mature tree, generally speaking, not always, the leaves are much smaller and only once or twice lobed, or entire.

The reverse happens in many cases, especially in compound-leaved plants; thus the first few leaves in seedlings of the Tulip Tree (*Harpullia*), the Native Tamarind (*Diploglottis*), and other Sapindaceae, Meliaceae, &c., are quite simple and entire, but are all pinnate on older plants.

Pulvinus.—The base of the leaf in many plants becomes thick and fleshy, and forms a cushion-like mass of tissue known as the *pulvinus;* this is especially well marked in many leguminous plants *Poinciana, Cæsalpinia, Mimosa* (or Sensitive Plants), *Acacia* (bi-pinnate species), &c. It is an irritable organ, and is very sensitive to light and various external stimuli, and by it the leaf can alter its position and so can not only protect itself from various external influences as hot and dry atmospheric conditions, but can place itself to the best advantage for receiving light.

Stipules (Plate 94).—Many leaves bear at their base two more or less noticeable bodies, one on either side of the petiole; these are known as stipules, and a leaf which bears them is said to be *stipulate,* and one which does not *exstipulate.* When these lateral outgrowths are found at the base of a leaflet they are called *stipels* or *stipellae.*

Stipules may be large and conspicuous, as in the young leaves of Carrabin (*Geissois*) (Plate 94, fig. 2) and Leichhardt Tree (Plate 94 figs. 3 and 4), or they may be small, as in many species of Tick Trefoil (*Desmodium*). Stipules often fall away before the full development of the leaf, as in the Moreton Bay Fig, &c. (Plate 94, fig. 7), the Flame Tree, &c.), and the Cotton Tree (*Hibiscus tiliaceus*) (Plate 94, fig. 1), in which they act as protecting organs to the young leaf.

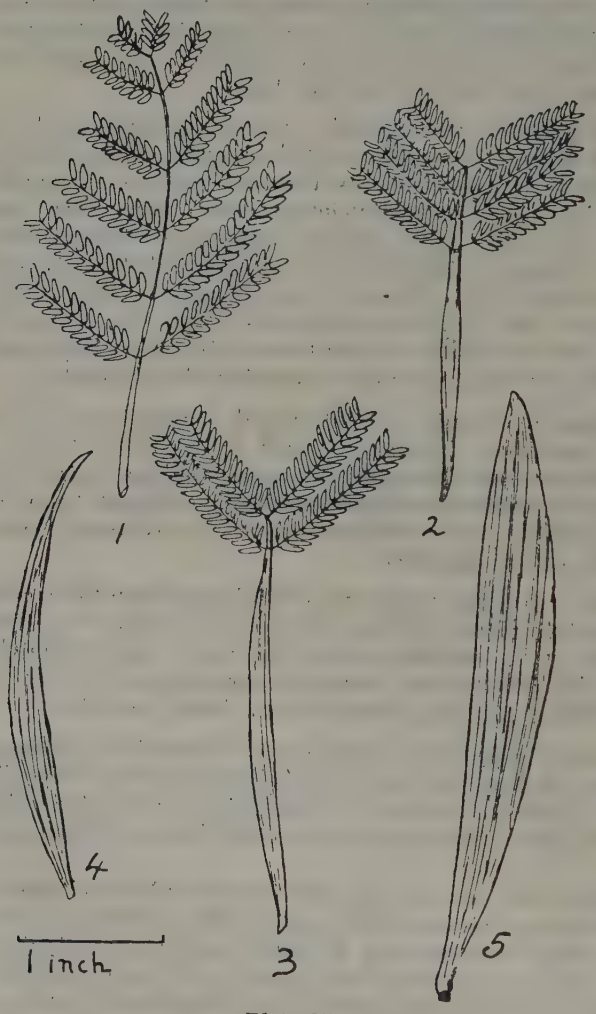


Plate 95.

Evolution of the Phyllode in Wattles.—*Acacia implexa*—1, 2, 3, and 4. Specimens taken from a fair-sized tree showing reversion shoots. In fig. 1 the leaf rhachis is terete or slightly angular, and is in all respects a typical pinnate leaf. In figs. 2 and 3 the rhachis is flattened and bears several pairs of pinnæ in the upper portion. In fig. 4 the rhachis is flattened, the pinnæ have been dropped and a typical Acacia phyllode formed, Fig. 5. Phyllode taken from large trees bearing typical phyllodes only.

Stipules may be free, only adhering by the base to the petiole as in the Moreton Bay Fig, or they may adhere by their inner margins for nearly their whole length to the petiole, in which case they are said to be *adnate*, as in the common garden rose.

In many plants with opposite leaves the stipules of one leaf become more or less united to the stipules of its opposite neighbour, so that there seem to be two large stipules, one on either side of the stem; they are termed *interpetiolar stipules,* and are well seen in the Leichhardt Tree (*Sarcocephalus*) (Plate 94, figs. 3 and 4), the Coffee, and many other plants of the family *Rubiaceae.* Interpetiolar stipules are often caducous, their main function being to protect the young immature leaves.

In many species of *Capparis* (Capers), the stipules are developed as small thorns, which are often hooked and aid the plant in climbing, as in *Capparis lasiantha* (Mulpup or Nipang) and *C. sarmentosa.* In several other plants they are also metamorphosed into spines, probably to repel herbivora. This may be seen in the Mimosa Bush and other certain species of *Acacia* (e.g., *A. farnesiana, A. horrida, A. Bidwillii, A. arabica,* &c), in *Robinia pseudacacia,* and in the Algaroba Bean (*Prosopis juliflora*).

In the Bumbil Tree or Native Pomegranate they are present on the young trees on lower branches, but disappear from the adult branches on larger trees.

Leaf-base.—Sometimes the leaf base is differentiated considerably from the rest of the leaf. This is particularly noticeable in a grass leaf, the base of which generally enfolds the stem in a sheath often of considerable length; at the top of this leaf-sheath is borne a small structure known as the *ligule* or *ligula,* the character of which—whether ciliate, jagged, or truncate, and so on—is an important feature to record when differentiating species of grasses, and if not present its absence should be noted, as in Japanese Millet and White Panicum.

Leaf Metamorphosis.—Leaves or their parts are often modified in various ways in order that they may be able to serve other functions than those of the ordinary foliage leaf.

(*a*) *Leaf Tendrils.*—Leaves or parts of leaves may form *tendrils* which cling round other bodies for support, fixing the plants and helping their upward growth to the air and light.

In *Flagellaria,* a "Supple Jack" of the coastal "brushes" or scrubs, and in *Gloriosa,* cultivated as an ornamental climber, the end of the leaf forms a spiral coil, which acts as a tendril; in the common garden Pea (*Pisum sativum*) several of the end leaflets form tendrils.

(*b*) *Pitchers.*—In certain plants the foliage leaves are modified into remarkable traps for catching small insects or collecting water.

In different species of *Nepenthes,* plants fairly common in the extreme north of Queensland, New Guinea, and Tropical Asia, and many of which are cultivated in hothouses, the lamina is metamorphosed into a *pitcher* or *aecidium,* bearing at its top a lid which is a development of the apical portion of the lamina, while the petiole in its lower portion is winged, and has a resemblance to and performs the functions of a typical leaf blade in addition to those of a petiole. The pitchers contain a certain amount of water, and a digestive ferment (pepsin) is secreted so that insects falling into the water in the bottom of the pitcher are first drowned and then digested. Other Australian plants forming leaf pitchers are the West Australian Pitcher Plant (*Cephalotus follicularis*), and certain species of *Dischidia,* epiphytic plants found growing on trees in tropical Queensland.

(*c*) *Leaf Spines.*—Occasionally leaves are metamorphosed into spines; the Gorse (*Ulex europæus*), a European plant naturalised in many places in Australia, provides an example. In this case the young seedling bears trifoliolate leaves, but in the older plants the branches, as well as the leaflets, are metamorphosed into spines. Many thistles and other plants bear spines as outgrowths of the margins, and the modification of stipules into spines has already been referred to.

(*d*) *Phyllodes.*—In some plants, the leaf-stalk is flattened to resemble and perform all the duties of a leaf blade—when it is known as a *phyllode*. Most of the Australian Wattles possess phyllodes in place of true leaves. In their case the phyllode is formed not only of the flattened leaf-stalk but the leaf-stalk and rhachis.

If a seedling wattle is examined the leaves will be seen to consist of two distinct parts, (1) a flattened leaf-stalk or petiole, and (2) a bi-pinnate leaf-blade or lamina, but as the plant develops these latter are shed, and in older plants they may not be developed at all. Some species, however, retain them much longer than others, and many carry them even when quite large plants. This is true of the great majority of Australian Wattles, although a few, such as *Acacia decurrens* and *A. Baileyana* (the Cootamundra Wattle), bear only typical foliage leaves throughout their whole existence.

That the Acacia phyllode is not the flattened leaf-stalk alone is proved by the fact that numerous transition forms between it and the ordinary bi-pinnate leaf occur. As the bi-pinnate leaves are generally conceded to represent the primitive type of foliage of the wattles and the phyllodes have simply been evolved in response to the dry conditions prevalent in Australia these intermediate forms between the bi-pinnate leaves and the phyllodes are spoken of as *reversion foliage*, and the shoots on which they are borne as *reversion-shoots*. Reversion-shoots are often seen on adult trees, but are absent from seedlings. Another fact is that the average petiole of the bi-pinnate leaf of a wattle is comparatively short—in the longest not being 3 inches, whereas euphyllodes up to 20 inches occur, while ones of 5-9 inches are very common—perhaps an average. The evolution of the Acacia phyllode is shown in Plate 95.

An interesting case in which a species—*Acacia rubida*—typically phyllodineous bore flowers and ripe pods on plants bearing bi-pinnate leaves only has been recorded. In a few wattles, such as the Blackwood (*A. melanoxylon*), and the Broad-leaved Sally Wattles (*Acacia implexa* and *A. maidenii*), though ordinarily dropping the pinnate leaves and forming phyllodes only when a few inches high, in moist sheltered positions may attain a height of 5 feet before producing any phyllodes.

[TO BE CONTINUED.]

Some Pasture Problems of Western Queensland.

Dr. E. HIRSCHFELD and R. S. HIRSCHFELD.

(*Read before the Royal Society of Queensland.*)

TO make grass grow where grass did not grow before is a noble aim. Wherever the soil is quickened into a heavier yield more men and women find new homes.



Plate 96.

Virgin Country on Bybera, the Property of Dr. E. Hirschfeld, in the Inglewood District.—Standing Brigalow and Belah scrub.



Plate 97.

Similar country after ringbarking prior to its being fired and put under grass.

Mitchell grass is the greatest of our pastoral grasses; but a Mitchell pasture has one great drawback—it is not heavy carrying country. Though most nourishing in themselves, the clumps of grass, except in an unusually good season, grow far apart, leaving bare patches between them.

In 1933, 5 acres were ploughed in one of the experimental paddocks of Bybera, and about sixty different plots were sown with imported and native grasses. They were then left entirely to themselves. It was obvious that in these experiments, if they are to be of any practical use, the pastures cannot be pampered, or else the test would not hold good for our large western grazing properties. So the grasses were left to fend for themselves, except that the stock was shut out or admitted, according to our discretion. It must be mentioned that the last good rains we had were in December, 1934, and January, 1935. Since then we have had a severe dry spell, being short by more than 12 inches in our rainfall over a period of twelve months. The deficiency of rain, though unwelcome to our stock, was of great value in testing the endurance of the grasses.

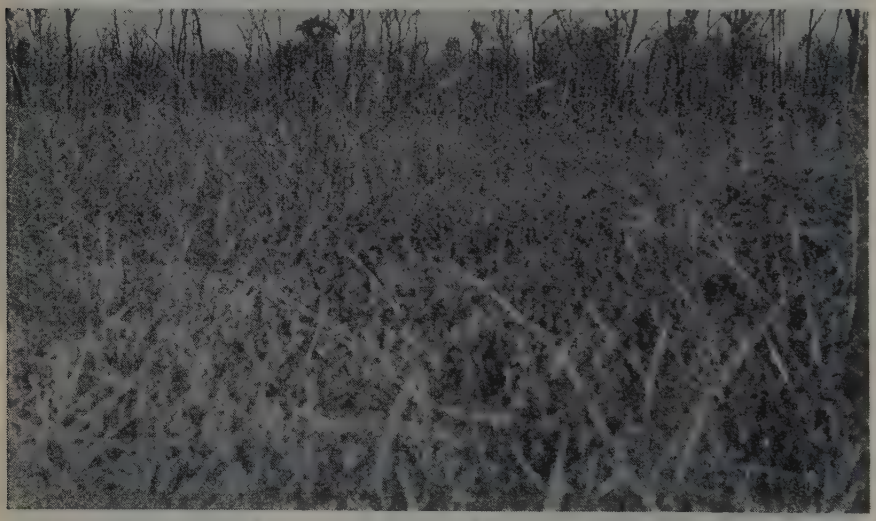


Plate 98.
A paddock of sown Mitchell grass on Bybera, Brigalow scrub in background.

Three years have gone. Of the imported grasses all have disappeared except one. Of the native grasses Mitchell, Flinders, and Brigalow have not only survived but flourished. A number of other native grasses are also growing but not flourishing. On the other hand the Mitchell is spreading over the paddock in the direction from south-west to north-east, and there beating the local native grasses. Westerly winds prevail when the seed is falling, and carry it in an easterly direction. The most remarkable feature about the stands of Mitchell is that they have thickened year by year, getting closer to each other, until, at the present time, they have become almost a continuous stubble covering the former bare patches. As mentioned before, the rain during the last season has been 12 inches short of our average.

We do not wish to weary you with all the "ins and outs" of our experiments, but will try to give you a connected story of our findings.



Plate 99.
Close view of Mitchell grass tuft or stool.



Plate 100.
A fine stand of sown Mitchell grass showing well-filled seed-heads.

Beasts and plants breed by means of fertilized seed. Plants, however, have yet a second way of multiplying; this is the asexual way, which has nothing to do with the generation by seed. Let us quote an every-day example known to most of us. When setting out strawberry plants the gardener places them at long distances from each other so that they may have sufficient space to send out runners over the intervening ground. From these runners, at short intervals, roots spring and enter the soil, forming new and independent strawberry plants. Many grasses show a similar habit of sending out runners and striking root at each joint. The lawn of buffalo grass is due to its asexual way of propagating. Rhodes grass owes its reputation as a quickly-growing pasture to its vigorous runners, and so does kikuyu. As a matter of fact the virtue of these plants as pasture grasses lies far more in the asexual way of multiplying than in the "legitimate" sexual generation from seed.



Plate 101.
A paddock of sown Flinders grass on Bybera.

Mitchell grass does not send out any runners. For the secrets of its growth we have to search in the roots. A Mitchell grain is planted; after a few weeks a single stalk emerges from the root. Soon the stalks increase in number and form a clump. When digging up such a clump of Mitchell three or four months old, or the older the better, we find a dense network of fibrous roots striking downwards deep into the ground. But within an inch or two below the surface a mass of buds becomes visible. These buds surround the roots like links of a chain, each being packed close upon the other; they are always arranged concentrically, the youngest buds outside, the older ones inside. From each bud springs a stalk; as the number of buds increase so increases the number of stalks and, of course, the size of the plant. In one clump several (three) years old we counted no less than 136 stalks. These buds continue to form and send forth stalks while the grass is growing. As the stalk is eaten off by the stock the bud to which that stalk belonged gradually shrinks and dies, making room for the newer buds.

Now the summer comes to an end; the grass above the ground dies off. It requires a continuance of cold weather to stop the growth of Mitchell. We had several frosts as low as 23 deg. F., and yet, as the weather warmed up again in this mild season, the Mitchell started to shoot again.



Plate 102.

How Flinders Grass flourishes in its new Environment.—A well-covered paddock on Bybera.

The live buds below the ground do not die with the coming of the winter; but they are no more capable of sending forth stalks. Some of them gradually enlarge into decent-sized kernels shaped almost like a bean except that they taper towards the free end. The biggest we measured was ¾ inch in length. The kernel itself when cut open lengthwise consists almost entirely of whitish nutritious matter encased in several sheaths of thin, fibrous tissue. The arrangement of these sheaths reminds one of the membranes with which important organs in man are clothed for their protection. It is another instance of the jealous care

with which Nature watches over all the means of reproduction. These close-fitting sheaths envelop the kernel as a number of coats do a man in rough weather. They shield it against the cold, against the wet, and against drying; thus they safeguard our most valuable fodder plant. If it had not been for these kernels with their protecting sheaths the crop of Mitchell after the breaking of the drought would have been disappoint-



Plate 103.
Saltbush on Bybera 7 feet high.

ing. When the winter rains came in the West twelve months ago it was these protective sheaths which prevented the moisture from gaining access to the kernels; otherwise they would have rotted or sprouted, and either would have been disastrous, for the cold following would have nipped and killed the tender shoots that had ventured above the ground.



Plate 104.

A saltbush hedge bordering the Bybera homestead garden.



Plate 105.

Apple Trees on Bybera.—Cool shade for stock is provided by the apple tree family.

But the kernels are not only the source from which a new plant springs in the coming summer, but they are also the winter storehouse of the Mitchell plant.

If science was not aware of these kernels, sheep certainly knew of their existence; they burrow for them and maintain life on them when the ground above is apparently bare of feed. Cobb and Co. were another party that must have known something about these buds and kernels. An old pastoralist with whom I discussed these matters informed me that Cobb and Co. used to buy Mitchell grass roots at so much per bag. The men who looked after the horses at the stopping places are said to have made a good thing out of collecting and selling Mitchell roots.



Plate 106.
"Leatherjacket" clump on Bybera.

Now we come to the practical application of these purely biological observations. We vision the Mitchell grass as it is growing in the summer. When a herd of bullocks are grazing in the paddock the first thing they pay attention to are the tender green shoots coming up from the buds surrounding the root. They are more succulent than the older stalks, which bear the seed heads. This stimulates the plant into forming new chains of buds and the new buds into sending forth more green shoots. An old plant that has been frequently fed off stools out into a larger and larger clump, with a dense mass of buds, the new ones at the outside being, of course, the youngest. Horses are partial to the seed heads, which are the plums in the pudding. But as horses do not chew the cud many of the seeds encased in glumes pass undigested through the intestines; hence horses become distributors of the seed. Sheep mostly confine their attention to the young shoots, bullocks eat shoots, seed heads, and also the stalks as feed gets scarcer.

But all this stooling out cannot go on indefinitely. If all the shoots are eaten off and not allowed to come to maturity no seed heads would form. In this case we should be deprived entirely of the sexual way of

propagating the Mitchell by the seed. In shutting up the paddock about the middle of February we allow the stalks to grow up, form seed heads, and provide the seed for next year's grass. It is not necessary to keep the stock out till all the seed has fallen. The stock may be admitted while a good deal of the seed is still on the ear. The stock in breaking off the blades shakes the seed out of the ear and makes it fall to the ground. At the same time it tramples the seed into the soil, and in this way acts like a harrow.

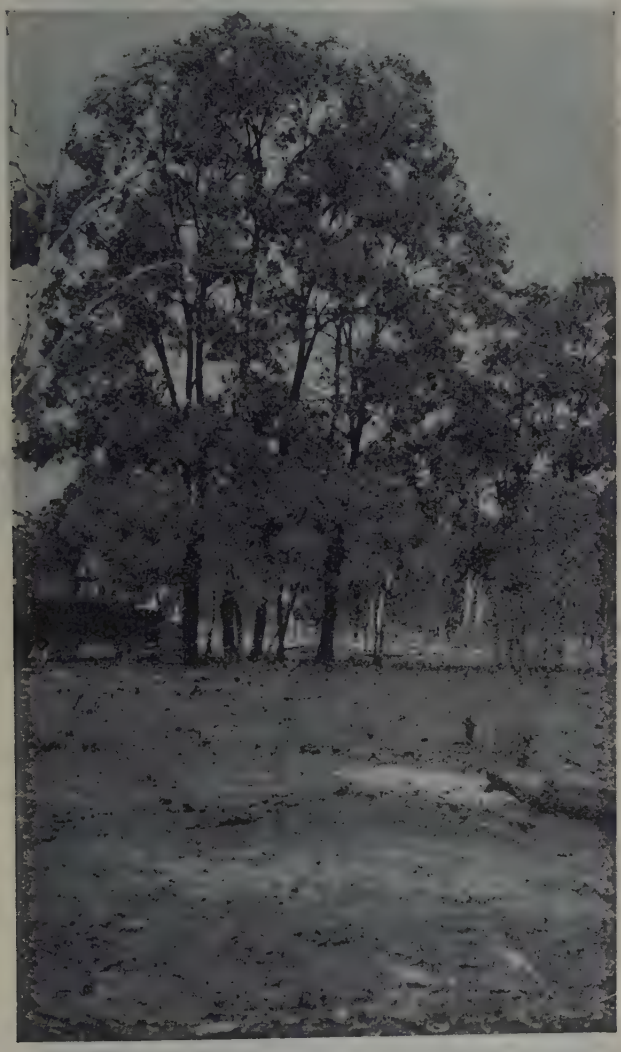


Plate 107.

A Brigalow grove retained as a future cattle camp on Bybera. Where clumps of Brigalow have been retained in the course of clearing on similar country a beautiful park-like landscape has been obtained.

You will thus see how we obtained our denser growth of Mitchell grass by making use both of the sexual and asexual method of propagation. We increased the size of the individual clump by allowing the

stooling plant to be fed off to the stock and thereby stimulating the asexual growth. In observing a brief close season while the grass was seeding we aided the sexual propagation by means of the fertilized seed.

A close season for grasses whilst they are seeding is as necessary as a close season for animals whilst they are breeding.

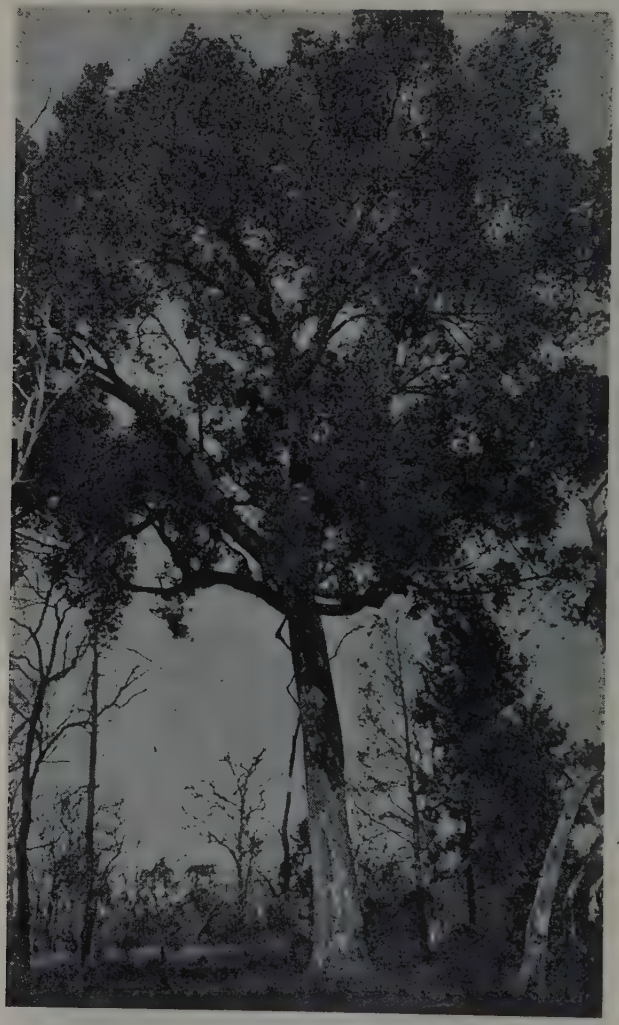


Plate 108.

A fine specimen of Kurrajong, one of the most useful of our native trees. The bole from the base to the first limb is about 30 feet in height.

No farmer could afford to feed his seed wheat to his stock. Neither can the grazier afford to kill the goose before it lays the golden eggs. He must protect his Mitchell grass whilst it is coming into maturity. To shut up paddocks in rotation at seeding time is really not a very great hardship, as February and March are the months when grass, as a rule, is most abundant in Queensland.

It is the close season for grasses which enables us adequately to provide for the next year's crop of Mitchell grass, and also for a denser growth of our best fodder plant.

RE-MINERALISATION OF THE SOIL.

We breed Aberdeen-Angus cattle on Bybera. The black poll is an early-maturing beast, which means that he has to build up his frame mainly in the first twelve months of his life. During the nine months the cow is carrying its offspring and whilst the calf is being suckled by its mother the soil has to furnish through its plants an unusually large amount of lime salts, phosphorus, and a number of other minerals. For mineral salts are builders of bone and builders of tissue.

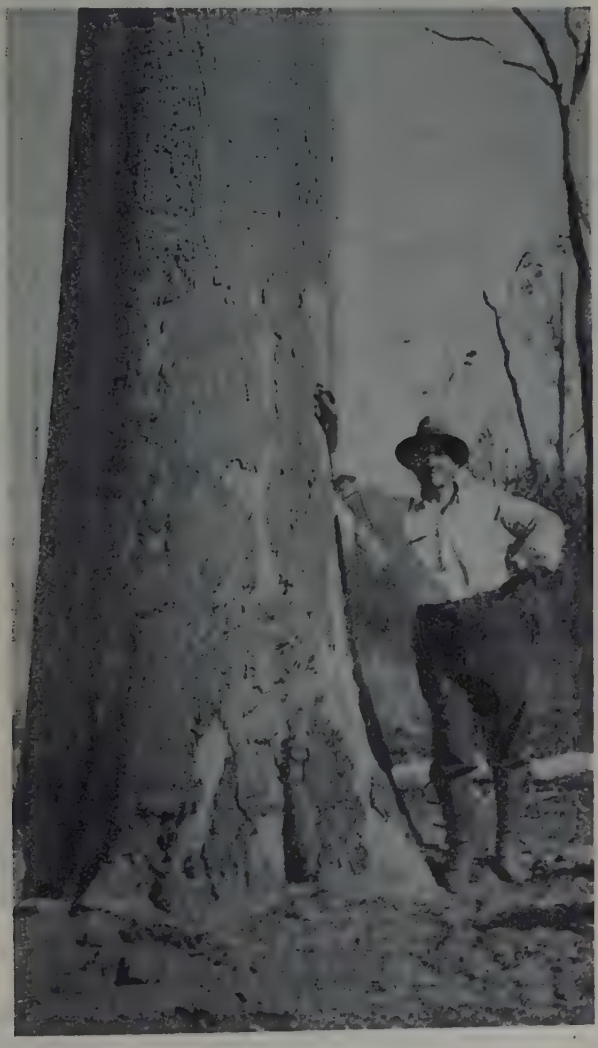


Plate 109.

The butt of the same Kurrajong, 21 feet in circumference at the base.

Bybera is principally brigalow and belah country just ringbarked, and therefore practically maiden ground. It is rich in lime, but like all our western country, carries but a moderate amount of phosphorus. Although the mineral exhaustion of our soil was not a danger likely to threaten us for many years to come, we began seriously to consider whether and what steps were advisable to counter it. Going into this opened up a very large subject which we believe to be of far-reaching importance for the whole of the State.



Plate 110.
A fresh in Commorin Creek, on Bybera.

Queensland has turned off its pastures annually during the last twenty-five years more than 500,000 head of cattle. Taking each bullock at an average of 6 cwt. it is easy to compute how much this country has been losing each year in mineral salts. Five per cent., or the

twentieth part of a beast, is represented by mineral matter, mostly phosphates of lime, contained in its bones and to a small extent in the other organs. This means that Queensland loses yearly at least 15,000,000 lb. of mineral salts. This does not take into account the mutton we send away, nor the butter, nor numerous other products of the soil. Without piling up the agony and overwhelming you with numbers, just keep in mind these 15,000,000 lb. of mineral matter being lost each year to the Queensland soil. It is true that the figure is becoming gradually lower, as we go back beyond 1910, right up to the beginning of the pastoral industry, but we have been grazing our country for the greater part of 100 years; during all that time it has always been a loss, and never anything put back. No soil, no matter how rich it is to begin with, can stand such a continuous drain. The consequences have been slow in coming, but they have come.



Plate 111.
Water supply at No. 2 bore, on Bybera.

Our better grasses, such as Mitchell, Flinders, browntop, and others, all of which require a high standard of living, are giving way to the poorer sorts, which are content with an impoverished soil. In the far West, where the soil was poor to start with and the rainfall less, even the poorer grasses are losing their roothold. They die. As they perish the desert creeps on and buries beneath its sand dunes what had been once a pasture.

A property devoted to breeding stands in need of pastures rich in phosphorus. *A cow carrying her calf, during part of that time requires fourteen times as much phosphorus as a bullock does of the same age.* Hence Nature provides that a sufficiency of phosphorus favours reproduction, whilst lack of it makes animals less fertile.

It was this consideration mainly which induced us to experiment with licks of varying composition. These licks were exposed close to where the stock was watering, and the animals that felt the need of it could use it. Man chooses his food according to his desires, and these desires are shaped by the instinctive needs of his body. A beast is not

so fortunate; it has to be satisfied with what his pasture has to offer. The pasturage may be wanting in some ingredients, yet the beast has to put up without it, just as sailors of 100 years ago had to put up with scurvy because they lacked fresh vegetables and fruit. The animal lives, grows, and breeds, yet it does not thrive. In a poor season, be that due either to less rain or a severe winter, the older cows will die before their time.

The experiments will not be complete for some time to come. The only obvious result, so far, is that we realised this season an exceptionally good price for our weaners, though we had been 12 inches short in our rainfall.



Plate 112.

The delivery pipe at No. 3 bore. When first tested the flow was 960 gallons an hour. It has since increased to 1,100 gallons. Water couch grass is growing on the batter of the tank, and as the water rises it spreads over the surface to some distance from the bank, thus probably reducing evaporation to an appreciable extent.

Some years ago a Belah tree had been cut down; the cattle left the grasses upon which they had been feeding, and devoted their attention to the fallen tree, which they picked clean of the leaves. Wondering why the stock should have preferred the leaves to the grasses, I surmised that probably they were desirous of a change of food, perhaps on the principle that the grass on the other side of the fence was always greener. Last April, while walking along the banks of Commorrin Creek which runs through our property, it was brought home to me, as it is probably brought home to everybody at one time or the other, how deep the roots of a tree can go down into the ground, and what an opportunity a tree has of feeding upon strata not accessible to an ordinary plant. In their search for food the roots spread and penetrate in all directions, even splitting up rocks and leaching out the nutriment they stand in need of.

Thus the tree would be able to tap a supply of minerals not available in the surface and subsoil. These minerals would mount through the sapwood and be used for the building up of the leaves. As the leaves fall to the ground and decay the minerals would be set free, enriching the surface soil quiet apart from the humus they form. *The living*

tree would thus be the means of re-mineralising our soil. Whether this train of reasoning was correct or otherwise could be easily settled by experiment.

A pound of leaves was collected from a number of trees well known as fodder trees—the Wilga, the Belah, and the Bulloak; also from a shrub which is known to be deep rooted—Old Man Saltbush. These leaves were submitted to the Agricultural Chemist for analysis.



Plate 113.

Windmill over a sub-artesian bore on Bybera. A recently burnt brigalow falling in the foreground.

The result is arresting. The Wilga leaves carry from three to ten times as much lime and at least as much phosphorus as the Mitchell grasses; the Belah about four times as much lime, but not as much phosphorus; the Bulloak, of which only the young shoots were collected, as they are greatly favoured by sheep, is still rich in lime and fairly rich in phosphorus. The most surprising result, however, is furnished

by Old Man Saltbush, which is richest in phosphorus and also abounds in lime; it shows nearly as much lime as the Belah, which was the starting point of our investigation.

Mr. Gurney, the Chief Agricultural Chemist, with whom I discussed the result, went through his records, containing the analysis of past years, which fully confirm the above results. Boree and Gidyea leaves from the Blackall district exceed even the Wilga in lime, though they were not so good in phosphorus. Mulga leaves from Charleville made quite a respectable showing. Many more may be quoted.



Plate 114.

A newly-planted avenue of native trees leads to the entrance to the Bybera Homestead.

I do not suggest that all these trees can take the place of grasses in feeding stock continuously. Some contain other substances which ultimately prove injurious. The Belah leaves, for instance, are rich in fibre which, after a while, tend to form into a ball in the stomach—especially in sheep, who, like cattle, are eager for them at first on account of the mineral ingredients. But all this does not lessen the value of trees, even of those that cannot be called fodder trees. **Many, if not all of them, act as re-mineralisers of the soil.**

On the basis of our experiments we wish to make the following proposals:—

First: In ringbarking country exceptionally large trees should be spared. The Forestry Department rightly exempts trees economically valuable, like ironbark, pine, and others. A grazier in his own interest will save all fencing timbers. But even apart from those, fine shade-giving trees should not be rung. Good trees furnish good seeds should they ever be required.

Second: A great portion of our western plains is treeless. The Forestry Department, with its staff of experts and experience, is in a position to conduct experiments to find out which trees can be made to grow there. It has been declared that the thing could not be done. When a man asserts that a certain thing can't be done it often amounts to no more than this particular man can't do it. Others might. It is unreasonable to expect the leaseholding grazier to put improvements on his country which are of more profit to his successor than himself. This is the business of the State, who is the owner and landlord, and has a lively interest in realising a better paying return in the shape of rent.

Third: *We urge the systematic planting of Old Man Saltbush.*

Trees are slow to grow, and the man who plants them often derives no benefit during his own lifetime except the delight at seeing them grow. In the saltbush, however, we have a plant that will spring up in a few years. For he is no immigrant, but a native of the Australian soil, tested by the droughts of a thousand years. It grows up to a good height—some of those we planted on Bybera are over 6 or 7 feet high. Its virtues are many, its faults hard to find. Its greatest drawback is that, like the Mitchell grass, it is so eagerly sought by the stock that it is eaten and destroyed before it can come to seed. Hence you cannot grow saltbush without fencing it off. To help it along the ground should be broken up. *If a strip of country is thus fenced in several places on the run the saltbush will not only grow but the seed will spread to the adjoining portions.*

Mr. Gurney's analyses prove that the leaves of Old Man Saltbush abound in flesh-forming substances containing no less than 21½ per cent. of protein, and with it very little indigestible fibre which makes the Belah undesirable as a continuous feed.

The outstanding virtue is the wealth of mineral matter in the leaves —lime, phosphorus, potash, and others. Mr. Gurney became so interested in the subject that he completed for me a differential analysis. *He found 46 milligrams of iron in 100 grams of leaves. This meant that saltbush carries more iron in proportion than spinach, or strawberries, or even the yolk of an egg.* My son's wife prepared sandwiches of saltbush leaves between bread and butter for afternoon tea. With a little enthusiasm they taste quite good. There is little doubt but that vitamins will be found in green leaves carrying such a high percentage of mineral matter. What that means to men, women, and children living in the West, and unable to grow vegetables, I need not dwell upon. But the stock is also in need of vitamins, particularly in a dry season, when the dried-up grasses have lost most of their vitamins.

Apart from the vitamins, the grazier who cultivates his saltbush will find that he has a live lick on his pastures.

The Artesian Waters of Queensland.

H. I. JENSEN, D.Sc.*

IN a very interesting paper on the above subject Mr. P. C. Tibbits, A.M.I.E. (Aust.), of the Queensland Irrigation Commission, advanced many new facts as well as many new ideas on the subject of the artesian water supply. The paper is a marked help to geologists.

Mr. Tibbits advances the view that instead of one great artesian basin we have in this State at least eight distinct artesian basins, separated by buried ridges. The notion is not absolutely new, although it is quite novel among writers on artesian questions. In my articles and contributions on the oil question, I have myself suggested a subdivision of the artesian basin into a number of basins through buried ranges dividing the artesian horizons.

Mr. Tibbits gives strong evidence that such subdivisions exist. That these separate artesian basins have outlets into the Gulf of Carpentaria on the north, and into the mound spring regions of the Lake Eyre district, and other parts of South Australia, on the west, is admitted by geologists. Mr. Tibbits's conclusions on this matter are not likely to be disputed.

In regard to the query, "Is the water plutonic or meteoric?" Mr. Tibbits leaves the problem as it was—hanging in the air. His evidence is absolutely inconclusive. One of the most interesting and important statements he advances under this heading is that the "equal pressure lines are approximately parallel to the north-west south-east direction." Important as this conclusion is it is what would be expected on either the plutonic or meteoric hypothesis.

Mr. Tibbits contends that the "*replenishment theory is sound,*" with which I think all geologists agree; but whether replenishment is due to meteoric, plutonic, or fossil waters is still left as a problem for future researches. Mr. Tibbits shows his open mind in recording some of the main objections to the meteoric theory, which he favours, rather than the plutonic.

There is one point in particular on which I cannot concur with Mr. Tibbits, that is, where he says "serious objection to theories which support a replenishment by plutonic water, is the fact that there is practically no evidence of similar supplies outside the artesian (cretaceous) area." My experience as a geologist in New South Wales, Queensland, and the Northern Territory is that whenever I am on plutonic, other igneous, or metamorphic formations I find numerous true deep-seated springs, especially numerous in volcanic regions, like the Buckland Tableland in Queensland, the Nandewar and Warrumbungle Mountains in New South Wales. In sedimentary areas such springs are very rare indeed.

Mr. Tibbits admits that buried ranges of igneous and metamorphic rocks subdivide the artesian basin. Why should these buried formations not emit juvenile waters just the same as the formations that outcrop, and why should the escaping juvenile waters not spread laterally in porous sedimentary strata capping the buried ranges emitting them?

The main object of these notes is, however, to point out that geological facts support Mr. Tibbits's conclusion about the definition of basins to a large extent. I cannot as yet see geological evidence of eight

* In a Paper read before the Royal Society of Queensland.

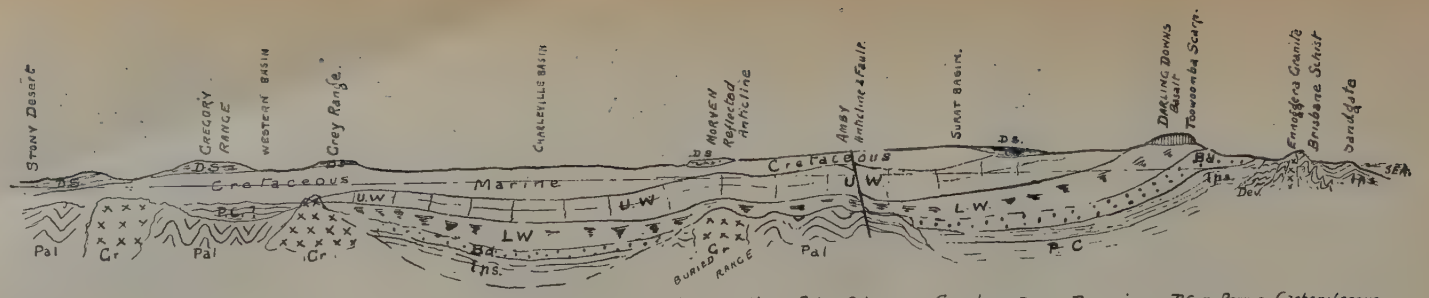
basins, although deep bores in the future may bring in facts corroborating Mr. Tibbits's hydrographic evidence. I do, however, recognise five distinct basins in Queensland separated by buried ridges and unconformities, viz.:—

1. The Surat Basin.
2. The Charleville Basin.
3. The Great Western Basin.
4. The Burketown Basin.
5. The Barkly Tableland Subartesian Basin.



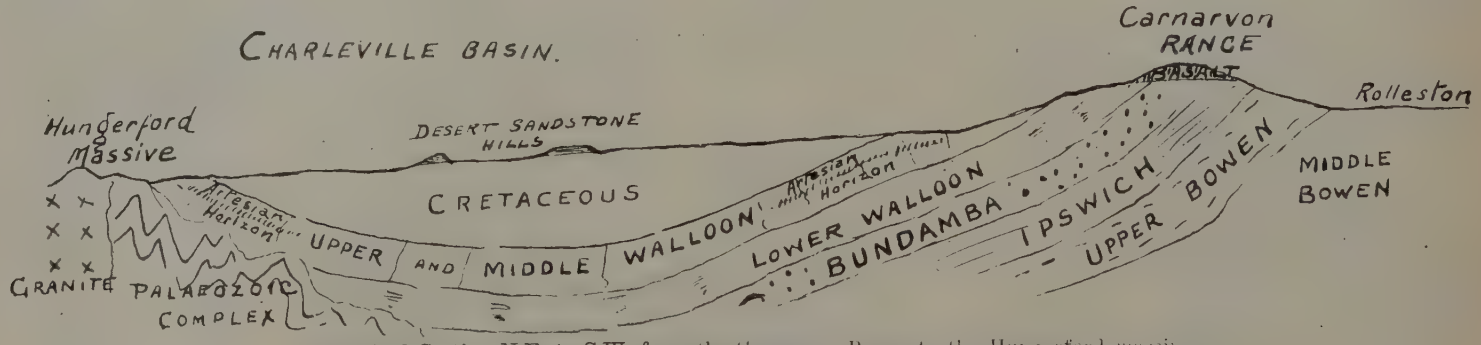
Plate 115.

Map of Queensland showing five artesian basins (including the Barkly Subartesian) divided by buried ranges.



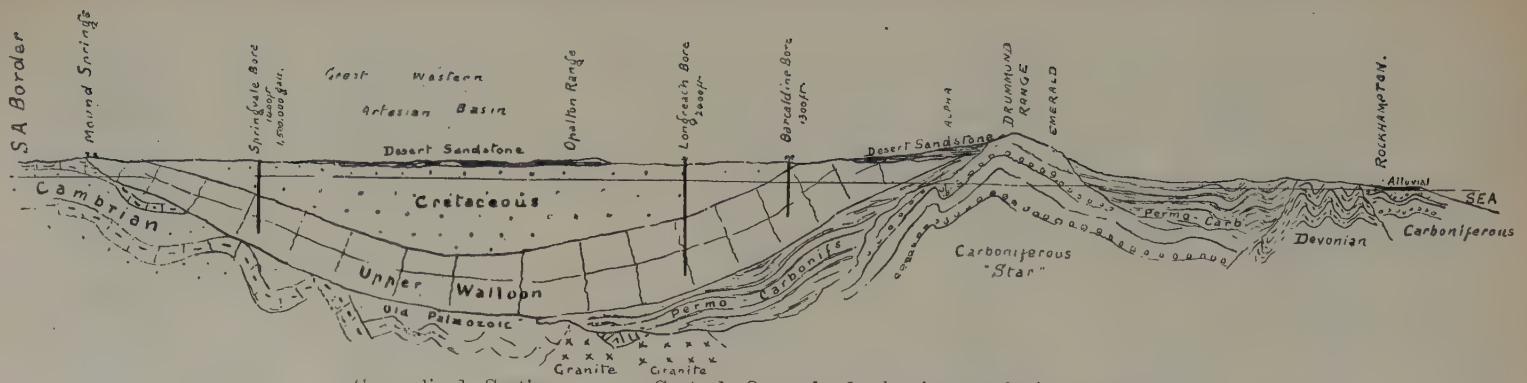
Gr = Granite ; Pal. = Palaeozoic Complex ; Dev = Devonian ; P.C. = Permo-Carboniferous ;
Ips = Triassic Ipswich Bd = Triassic Bundamba ; L.W = Basal = Lower Jurassic (Walloon)
U.W = Middle = Upper Jurassic (Walloon) ; D.S = Desert Sandstone (Cretaceo-Tertiary).

Generalised Section across South Queensland showing geological structure.

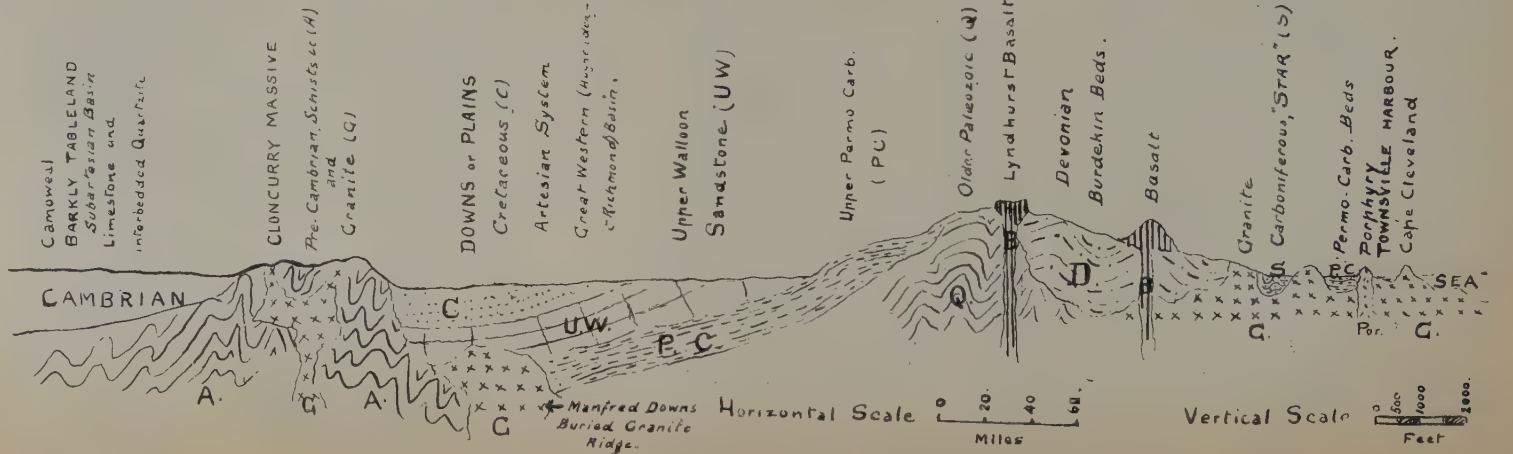


Generalised Section N.E. to S.W. from the Carnarvon Range to the Hungerford massive

Plate 116.



Generalised Section across Central Queensland showing geological structure.



Generalised Section through North Queensland showing geological structure.

Plate 117.

The first four draw their waters essentially from Upper Walloon rocks, though in the case of the third and fourth, Upper Permian rocks may be a contributing factor as in the Northern Territory.

The fifth is purely a subartesian basin separated from the others by a big unconformity.

I am submitting a map of Queensland showing approximately the extent of each of these basins, and four sections across Queensland showing the structure of the substrata as far as present evidence goes.

Basin No. 1—that of Surat—is separated from the Charleville basin (No. 2) by a buried range which is marked on the surface by the "reflected anticline" of the Iloganthulla Range and continued south-west therefrom through Morven and the valley of the Nebine.

Basin No. 2 is separated from the Great Western Basin by the Gowan and Grey Ranges, which appear to be reflected anticlines capping buried metamorphic ranges.

The No. 3 (Western Basin) is separated from the Burketown Basin by a buried granite range between the Woolgar and Cloncurry masses of very old rocks. The artesian waters along this ridge or col are shallow, as at Saxby and Manfred Downs, and many bores bottom on granite at shallow depth.

The Cambrian subartesian basin is separated from Basins No. 3 and No. 4 by an unconformable junction, along which the waters of adjoining basins escape as mound springs—namely, along the Hamilton River and Mulligan River in Western Queensland.

Of that subdivision of the artesian basin there is much geological evidence at present. There may in time to come be further evidence forthcoming of a more minute subdivision of the artesian basin, as suggested by Mr. Tibbits.

THE FRAGRANT WEED.

Discussing the increase in pipe-smoking in England, where, it is estimated, 10,000,000 more lb. of tobacco will be smoked this year as against the 1935 quantity, the director of a leading tobacco company gives three reasons for smokers taking more to the pipe.

He thinks that young men, taking to smoking for the first time, turn to pipes as being less effeminate than cigarettes—which their mothers and sisters are smoking in large quantities.

Secondly, among practised smokers the cigarette is giving way to the pipe in the cause of economy.

Thirdly, the modern pipe is a better product. There is a much greater variety of pipes to-day, with weights, balance, and mouth-pieces to suit all tastes.

The war is blamed for the fashion of smoking among women. Wars have always had a remarkable effect on smoking. The Thirty Years War spread smoking throughout Europe for the first time; the Napoleonic wars introduced cigars to Britain—they were brought back by the soldiers who fought in Spain, where the cigar has always been the most popular smoke medium; and it was the Crimean War that started the Englishman off on the cigarette habit—again the soldiers brought the craze back with them. The European War merely intensified the habit among men, and introduced it to women.

Shade Trees.

W. D. FRANCIS, Assistant Government Botanist.

[*Continued from p. 58, July, 1936.*]

PART II.

TREES ON THE FARM—THEIR PRACTICAL VALUE.

PROVISION for shade in forested areas is most conveniently and economically made when a farm area is being cleared. In clearing a farm on forest country a few trees of the most desirable types may be left at intervals to serve as shade for stock. It often happens that while clearing this class of country, in the eagerness to get rid of the trees, the matter of shade is entirely forgotten. Very much of the clearing of forest farms is done by ring-barking. When arranging for ring-barking stipulations should always be made for the preservation of the requisite number of the most suitable types of trees to serve as shade and shelter for stock.

In clearing a scrub or jungle farm it is more difficult to preserve trees. The scrub fire, a very necessary part of clearing, mostly kills the trees with which it comes into contact. In rain forest or scrub areas, to prevent the destruction of any particular tree, it is necessary to leave a considerable area of the standing scrub around the tree. To this procedure there are certain objections. It is often claimed that such isolated areas of scrub harbour wallabies and bandicoots, which live on the young grass and bananas. Although this is found to be true in actual practice, there still remains the problem of providing shade and shelter for stock. This is not a pressing need at the beginning of a scrub settlement, when clearing is going on. But in later years, when all the scrub has gone, it becomes an acute problem. Money has to be laid out in the purchase of trees, and much more money and labour have to be expended in erecting guards to protect the young trees from browsing stock. It is surely more economical to leave selected areas of standing scrub in different parts of the farm as shelters and shade for stock and sanctuaries for native birds.

It often happens that in clearing scrub farms in some places the fire is less intense than others, and some of the tree stumps escape contact with the fire. Some of these stumps shoot, and, if left alone, develop gradually into shapely trees. One of the most useful and beautiful collections of shade trees I have ever seen was produced in this way. Several common scrub trees, such as the Booyong and Axe-handle Wood, are represented in this collection of native scrub trees. It was of particular interest to me, for I had never seen these different kinds of scrub trees growing in the open, although their long stems were quite familiar in the dense, crowded jungle. It is evident that these scrub trees, when allowed to develop in the open, form particularly graceful types, with rounded heads of dense foliage, providing excellent shade for stock.

Figs as Shade Trees.

On farms which have been cleared of the forest growth the planting of shade trees is necessary. The months of July, August, and September are the most suitable for planting most of our shade trees. There is a very wide range of choice of trees to plant in most parts of the State, except in very dry far-western areas. Fig trees are recommended.

They provide excellent shade, are comparatively fast growers, and the leaves and fruit of some varieties, when they fall to the ground, are readily eaten by stock. Their spreading habit makes them especially suitable for planting in the vicinity of stockyards.

As a group the fig trees are exceptionally numerous. There are over 700 different kinds. They are found in the tropics and subtropics, but most of them are native to Malaya. Queensland has over fifty varieties of native fig trees, of which the best known is the Moreton Bay fig. This tree is found growing naturally in the jungle lands from the Shoalhaven River, in New South Wales, to Rockingham Bay, in North Queensland. Its round fruit is about an inch in diameter, and is almost purple when ripe. Other well-known native fig trees are the green-leaved Moreton Bay fig, the small-leaved Moreton Bay fig, the small-leaved fig, and the white fig. Seedlings and very young trees of the different figs are often found in the rain forest or jungle.

In nature most of the native figs grow on or around other trees. Occasionally they root and grow straight out of the ground, but much more commonly they start life on the bark of other trees, which they envelop with their roots and eventually kill by pressure. Advantage of this peculiarity is often taken by growing these trees for shade on old stumps on the farm. Peat from the base of staghorn ferns is placed on the top of the stump. Loose soil may be used where peat is not available, but peat is preferable. The young fig tree is planted in the peat or soil on the stump. Eventually the young tree sends its roots down to the ground on the surface or through cracks in the stump. This method of planting makes the use of tree guards unnecessary, and the young trees start off with the advantage of having attained a certain height without growing upwards to it. Hollow logs are especially suitable as stages for planting fig trees on the farm. A hollow log can be cut to any suitable length, say 8 feet. Some peat or rich vegetable mould is placed in the hollow of the log and the log is placed upright and held in position by three or four stays. A young fig is planted in the hollow at the top of the log. In the course of time the roots of the fig tree pass down through the pipe of the log and split it apart. When this has occurred the tree is supported by its own roots. Very suitable hollow logs for this purpose can often be obtained in places where posts and rails have been split. The discarded inner parts of logs with a pipe or hollow in them form excellent "pots."

Other Trees of the Jungle.

In addition to the native fig trees many other native scrub* trees may be used for shade. Some of the most attractive foliage trees of Queensland jungles are the Crow's Ash, the Cudgeree, the Yellow-wood, and the Tulip-wood. All, or most of these trees, may be obtained from Queensland nurserymen. Some of the native jungle trees serve as flowering trees as well as shade trees. Among them are the Silky Oak, the Flame tree, Wheel-of-Fire tree, and Native Frangipanni. Most of these may also be obtained from Queensland nurserymen. The Kurrajong and the Bottle tree are two excellent trees which serve the dual purpose of shade and fodder. They are grown in the dry western parts of the State as well as on the coast. In coastal areas, however, they are often slower in growth than many of the trees mentioned previously.

* The term "scrub" is really a misnomer. Early settlers in Queensland described rain forest wrongly as "scrub," and the designation persists, although obviously misapplied.

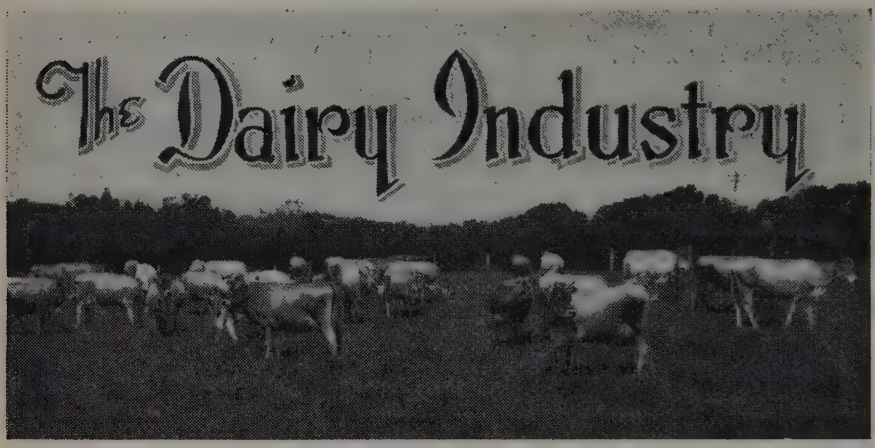
In Western Queensland, fairly large bottle trees are transplanted from the bush and grown around station homesteads. The roots are cut a few feet from the stem, and the whole tree transported on a wagon or truck to its new home.

Quite recently, while in the Peachester district, and in the Currumbin and Tallebudgera valleys, I noticed the remarkably pleasing and ornamental effects of the numerous hoop pines which are growing on the farms of these areas. These trees are fairly quick growers in the open, and provide a considerable amount of shade for stock. Quite apart from their economic value for shade purposes, these trees, with their symmetrical form, impart a park-like effect to farm lands. In this way their presence on a farm should enhance the value of the land purely through their attractive effect.

Several other well-known shade trees include the common Camphor Laurel, the Black Bean, or Moreton Bay Chestnut, the Bunya Pine, and the White Cedar. They have not been specially recommended, because there are certain objections to their use. The Camphor Laurel when in fruit is harmful because a strong camphor flavour is imparted to the eggs of fowls which eat the fruit. The seeds of the Black Bean are reputed to be poisonous to stock, although so far as I am aware instances of stock eating the seeds are very rare. The Bunya Pine has been accused of unsuitability for shade purposes because the prickly leaves on the branchlets shed by the trees render the ground unsuitable for stock to lie on. The yellow berries of the White Cedar are poisonous to pigs.

TANNING SKINS.

To tan skins in wattle bark liquor fill a kerosene tin about three parts full with well-bruised green wattle bark taken just off the tree, clean and free from gum. Fill the tin quite full with water, and boil slowly for one hour; strain into vessel (wooden or earthenware preferable). The liquid will be a very dark colour. Leave the same bark in the tin and fill up again with water, boil slowly for another hour for a second brew. Pour this in with the first lot. The second lot will not be so dark as the first, and the two mixed together will make the proper strength. Wait till cold, and immerse the skins, taking care to place fur to flesh, which enables the liquid to surround them better. All skins should be pegged out before placing them in the tanning water. Keep them as square as possible by stretching them well out under the shoulders. This saves a lot of trouble afterwards. Some people tan them as soon as skinned, but there are objections to this plan. They are apt to curl up in the liquid, which produces unequal tanning. They are difficult to dress, and no amount of stretching afterwards will give them a nice flat surface. It is very necessary to attend to the skins every day for the first week. Take each one out of the tan water separately, hold it up by the head with one hand, and with the other run the liquid off into the vessel. Lay the skins on a flat board—a kerosene case will do—flesh side up, and scrape downward with a blunt knife. Squeeze all the liquid out by repeating this process all over the skin. Any places which appear white need extra dressing, as they contain fat, which should be thoroughly removed to ensure perfect tanning. Three or four minutes is time enough to spend upon each skin. During the second week every second day will do for attending to them, until they are finished, which will be in from eighteen to twenty days. When finished lay them out on the grass to dry or hang them suspended on a clothes-line with a piece of string through the eyeholes of the head. Do not put them across a line because this forms a ridge and is hard to flatten out. Do not dry them in the sun. If on the grass keep turning them occasionally and rubbing them between the hands.



FOOD FLAVOURS OF MILK AND CREAM.

E. B. RICE, Dairy Research Laboratory (Dairy Branch).

OFF flavours in milk and cream arising from the food consumed by the animals are very prevalent in Queensland at certain times of the year, particularly in the spring, when a profuse growth of weeds follows the first of the seasonal rains and is assisted by the warmth. Volatile or non-volatile compounds which pass from the food through the bloodstream into the milk give the off flavours to the milk.

Food flavours can be distinguished by smell and the impression which they convey to the sense of taste when first placed on the palate. The characteristic flavours of the different foods enable the experienced grader to state accurately which plant is responsible. In passing, it may be mentioned that any food flavour in milk will be more pronounced in the cream separated therefrom on account of the ease with which flavours and odours are taken up from the surroundings by milk fat.

The defects of this type may be subdivided into feed flavours and weed flavours, respectively, according to whether their mode of origin is from plants of economic value or otherwise. Depending upon whether the taint is completely or partly removed by the factory treatment, or is carried through in undiminished intensity into the resultant butter, cream affected with a feed flavour may be classed as choice, first, or second grade, but weedy cream is always graded lower than choice on account of the impossibility to completely eliminate the objectionable flavour.

FEED FLAVOURS.

Brief reference will be made to some of the feeds commonly used in Queensland which are known to taint milk.

Silage when fed in large quantities one hour prior to milking imparts a taint to the milk. Small quantities in the ration do not have any noticeable effect.

The result of feeding green lucerne and green clover is generally well known. Lucerne hay and clover hay behave in a similar manner, but lesser amounts of these more concentrated feeds will give tainted

cream. Cream having a pronounced lucerne or clover taint is sometimes graded as low as second quality because of the impossibility to manufacture it into a high-grade product.

Rank pasturage materially affects the flavour of the milk produced by animals consuming it abundantly, but the experience in factories where the cream is subjected to treatment in a partial vacuum after pasteurisation is that the butter made from such cream is improved in grade by one to two points since the adoption of this method of treatment.

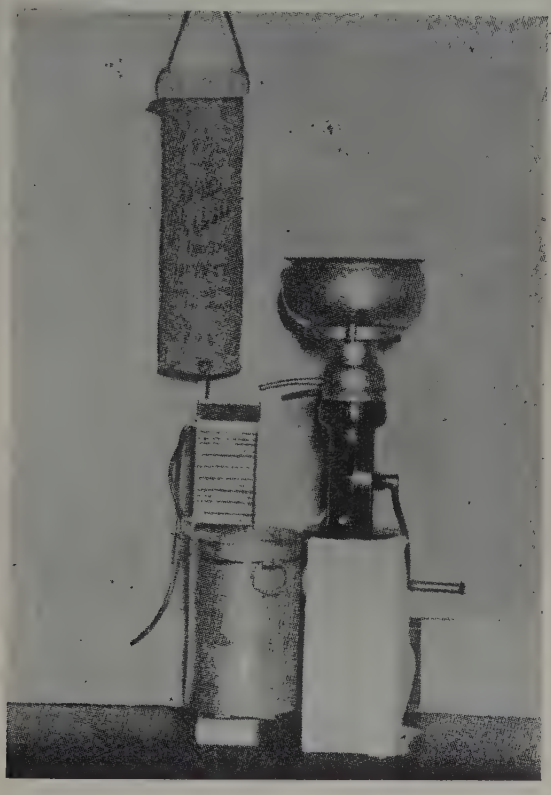


Plate 118.
An Efficient and Inexpensive Cream Cooler.
[*Illustration by courtesy of the Tasmanian Journal of Agriculture.*

A musty flavour can sometimes be discerned in cream, and is often traced back to the feeding of musty or mouldy hay or chaff, although the defect may be of bacterial origin. The bacterial type is the worst, for it is intensified by the processing in the factory.

Cream from cows which have been fed on green barley may be graded down by the factory, but this flavour is usually removed by factory treatment. Green rye and green cowpeas produce slight flavours which are not usually looked upon with disfavour in cream to be used for butter making.

Turnips, onions, and garlic seriously taint the milk of any animals consuming them, while pumpkins, potatoes, and cabbage will also give a distinct taste which is objected to by city milk consumers.

Time Required for a Feed Flavour to Appear.

With most feeds it is found that the time which must elapse after ingestion until the undesirable flavour and odour appear in the milk is about one hour. However, the action of garlic is so rapid that its flavour is discernible one minute after it has been consumed.

Control of Feed Flavours.

Aeration of the cream on the farm, by passing it after separation over a surface type cooler will completely eliminate slight taints, but if stronger they are only partly removed. Pasteurisation in the factory will further reduce the intensity, but pronounced flavours may still persist. Treatment of the cream immediately after pasteurisation in a partial vacuum, which is carried out in many factories in this State, will renovate most feedy cream.

By feeding any of the fodders suspected at least three hours prior to milking, or, better still, immediately afterwards, the cream is not likely to be graded down unless the animals have partaken of large quantities of a feed like lucerne. So far as the production of milk for the city retail market is concerned, however, it must be borne in mind that feed flavours can sometimes be detected in the milk up to five hours after the feed has been ingested.

WEED FLAVOURS.

The non-volatile nature of the flavouring substance acquired by milk and cream which are affected by weed taint prevents its removal by aeration, pasteurisation, or vacuum treatment, and so the resulting butter is reduced in quality and depreciated in value. Some of the milk-tainting weeds which flourish in the dairying districts of this State are:—Mustard weed, carrot weed, stinking roger, hexham, cress, garlic, pepperwort, New Zealand spinach, pennyroyal, lantana, turkey berry.

Controlling Weed Flavours.

To control the incidence of weed flavours at certain times of the year may be a difficult task. Grazing the animals for a short time on a paddock badly infested with obnoxious weeds, then removing them to a cleaner paddock, will help to overcome the trouble, but the objectionable flavours imparted by some weeds remain in the milk for hours after ingestion. In some countries renewal of the pastures after intervals of two years is advocated as good practice in the control of weeds.

MAKE THE COW COMFORTABLE.

Keep cows' teats in good condition. In cold weather, chapped teats are not uncommon. This is sometimes brought about by washing in hard cold water without properly drying afterwards. Use soft warm water with a little Condy's in it for washing the cows' udders and teats and afterwards dry them carefully. A little vaseline—non-odorous—applied to the teats protects them and also makes for easier milking. Do not wet the teats with milk. It is an insanitary habit. Cow comfort and clean milk are desirable objectives easily secured by a little care and consideration.



FOLLOWING on the satisfactory June rains, further welcome falls were received in all divisions on 4th and 5th July. The registrations were particularly heavy in the Central and Northern districts, while the Western Downs and Maranoa received over an inch. From 6th July to the 17th, unsettled weather prevailed, yielding further beneficial showers which were of great assistance to young growing crops.

Wheat.—Farmers lost no time in taking advantage of the favourable seasonal conditions, so that sowings were practically completed by mid-July. The record demand for seed wheat from the State Wheat Board indicates that a larger area has been placed under crop than in previous years.

The general sowing has been somewhat late, but providing good rains are received during August and September an excellent yield is in prospect.

The Department of Agriculture and Stock has again established breeding and experimental plots at Kincora, Rose Hill, Nobby, Dalby, Brigalow, Roma, and also in the Central district at Theodore and Biloela.

There is every prospect of an increase in world wheat prices, owing to the reduced acreage sown and to the droughty conditions being experienced in Canada and the United States of America. The U.S.S.R. have now displaced the U.S.A. as the world's greatest producers of wheat, oats, and barley. The British Empire's production of wheat, barley, oats, maize, and rice comprises 23 per cent. of the world's crops.

At present India is the Empire's greatest producer of rice, maize, wheat, and barley.

Sugar.

Cool, somewhat unsettled weather conditions have prevailed in the tropics north of Townsville, with cool, dry weather southward. Cane growth has been at a standstill and in the Northern areas the planting of the 1937 crop has been seriously delayed. There continues to be an almost complete freedom from frost.

Practically all mills are now crushing; the sugar content of the cane is uniformly low, but is improving slightly under the influence of cool, drier conditions.

Spring Sowings.

Land prepared for summer-growing crops can now be sown with a variety of fodder, hay, and grain crops, such as maize, sorghum, millet, sudan grass, and cowpeas. The majority of farmers now recognise the necessity of making provision for recurring dry spells and also for the winter months, when the growth of natural pastures is considerably retarded. During favourable seasons, good results can be obtained by the cultivation of winter cereals and legumes, but it is to the more vigorous growing summer crops that stockowners must look for the provision of their chief requirements in hay, fodder, and silage.

Maize can be grown successfully on a great variety of soils within the 30-inch rainfall region, deep alluvial soils being particularly suitable for its full development. Land ploughed deeply during the winter should now be in good condition as a result of cross-ploughing and harrowing, and it is well to remember that no amount of inter-row cultivation will undo the effects of sowing on hastily prepared land.



Plate 119.

This field of Sorghum, on Coreena Station, near Barcaldine, at about two months' growth, cut 12 tons per acre. Crop just before harvesting for pit ensilage.

[*Photo. W. C. Miller, Barcaldine.*

Maize crops are usually termed early or late, but as sowings may take place from August to late December, no definite sowing period can be recommended, weather conditions being the deciding factor.

For grain purposes, the chief essential is to assure adequate moisture during the tasselling stage; 9 to 10 lb. of sound seed per acre will be found sufficient, sowing in rows 3 ft. 6 in. to 4 ft. apart, but for fodder or silage purposes double this quantity can be used, choosing a leafy variety, such as Reid's Yellow Dent.

The sweet or saccharine *sorghums* are also widely grown throughout the dairying districts, as they provide a large bulk of nutritious and palatable fodder.

Although slightly less nutritious than maize, the sorghums will withstand dry conditions much better, while they also retain their succulence for a period after maturity, making them specially valuable as early winter feed. In cultural requirements, the crop is somewhat similar to maize, sowing being effected in rows 3 ft. to 3 ft. 6 in. apart, which will be found to utilise approximately 5 lb. of seed per acre. Sorghums are frequently sown broadcast, but although a finer stalk is produced, the total yield is often reduced by this method, besides which weed growth is apt to be troublesome during the early stages of growth.

For silage purposes, sorghum should be cut when the grain is well formed but still in the soft dough stage. Saccaline imphee and White African are popular varieties.

Where a quick-growing summer grazing or hay crop is desired, the *millets* can be confidently recommended, as they will produce fair crops even on the poorer soils.

The seed is usually drilled or sown broadcast, at the rate of 12 to 15 lb. per acre, and under favourable conditions the resulting crop will provide good grazing within five or six weeks. However, it is preferable to exclude stock until the plants are 8-9 in. high, when the roots will have a sufficiently good, strong hold to withstand grazing.

For hay purposes, cut when the grain is in the soft dough stage, and if a binder is used, make small sheaves and stook in windrows. The varieties known as Japanese millet and White Panicum have given the best results.

Sudan Grass is also excellent for grazing or silage purposes, and is considered to be the best possible summer crop for the drier farming areas such as the Western Downs and Maranoa.

It is better to drill in the seed, using approximately 7 lb. per acre, but if broadcasting double the quantity will be required. The risk incurred in allowing stock access to Sudan Grass prior to the flowering stage has been stressed in previous issues of the "Queensland Agricultural Journal." However, the risk is taken by many experienced stockowners, who have fed the crop during all stages of growth without ill-effects.

The Cowpea is now widely recognised as a valuable green manure crop, resulting in the development of a good trade in locally-grown seed. Its profitable utilisation as a fodder crop is also receiving attention by progressive dairymen, as it is highly nutritious, provides a good bulk of fodder, and is valuable as a rotation crop. Stock can be readily accustomed to green cowpea by sowing in conjunction with maize, either in the maize drills or in alternate rows. The seed varies greatly in size, according to variety, so that when sown in drills 3 ft. apart from 5 to 15 lb. seed per acre will be necessary. Poona, Groit, and Black are popular varieties.

With all spring-sown crops much better results are obtained when inter-row cultivation is thoroughly carried out, although, as previously pointed out, the initial preparation of the land, involving winter fallow, is of primary importance.



No. 10.—THE BULLOCK'S HEART.

S. E. STEPHENS, Northern Instructor in Fruit Culture.

THIS Anona is a poor species of the same family as the Custard Apple, and is known botanically as *Anona reticulata*. Some confusion has been brought about regarding its identity in this country by the unfortunate identical naming of a variety of custard apple some years ago. In many people's minds the confusion thus caused still exists.

Originating in tropical America, the tree has been much more widely distributed and planted than its quality merits.

The tree normally grows up to about twenty feet in height and is of upright habit. It may be distinguished from the Sugar Apple (*A. squamosa*), which it resembles, by its larger leaves and generally coarser appearance. Like the Sugar Apple too, it is deciduous, and usually remains bare of leaves for several weeks.

The fruit is typically heart-shaped, hence the common name applied. The skin is smooth in comparison with the Sugar Apple, the scales being flatter and the interstices less deeply indented. In colour of skin the ripe fruit is reddish-yellow or reddish-brown. The flesh is milky white, rather coarse in texture and usually of very poor flavour. Seeds of dark brown colour are numerous.

The fruit hangs late and may frequently be observed still on the trees when a large proportion of the foliage has been shed. Very fair crops are frequently carried, but the trees are not usually so prolific as the Sugar Apple.

The tree is tropical in requirements of climate, and thrives best under fairly heavy rainfall. In Queensland the best specimens are to be found in the Clump Point and Innisfail districts, where the annual rainfall is between 100 and 150 inches. The soil preferred by it appears to be a rich loam or sandy loam, such as may be found in some of our coastal jungles.

It is very seldom that the Bullock's Heart receives any cultural attention, even when it is grown for its fruit. This is decidedly a mistake, as even the poorest of fruit may be improved by care. A little cultivation of the soil round the tree will assist to maintain its health, while the incorporation of humus and a little complete fertilizer will improve its vigour and cropping capacity. Pruning also will assist in maintaining vigour. It should be carried out in the spring, just as the sap commences to rise.

PRUNING OF GRAPE VINES.

F. L. JARDINE, Plants Inspector, Stanthorpe.

As the subject of pruning will occupy the attention of grape growers for some months to come a few notes dealing with this work may be helpful to intending growers, also to those who from lack of experience are not fully conversant with the work, for, unless the pruner has some knowledge of the habits of the vine and an idea of the rudimentary principals of pruning he can not expect to gain the best results from his work.

Nature intended the vine in its natural state to be a creeper, on fertile soils often covering a wide area and composed of long slender canes producing very little fruit.

The use of the saw and secateurs brought about a radical change in its habits, for, instead of growing as a creeper, it has been forced for commercial purposes to adopt the habits more of a shrub or bush.

Curtailing its liberty to this extent has naturally lowered its vitality, and instead of producing a vigorous growth of canes with little fruit it feels its decline and turns all its energy to the production of fruit.

This point is of vital importance to the pruner, it being an easy matter to produce huge crops of practically no market value at the expense of growth and at the same time undermining the constitution of the vine.

Vines distressed by wrongful pruning and overcropping often take years to recover.

Experience has taught that some varieties of vines are more fruitful on the first and second buds and others on the third and fourth and even more; in the light of this knowledge the pruning of grape vines has been divided into two methods—viz., Short pruning, suitable to those vines that bear on the first buds, and Long pruning, adopted to varieties that produce their bunches further along the canes.

It is to the first system, short pruning, that we will direct our attention in these remarks.

The fruit of the grape vine is produced on the canes of the current year's growth exactly opposite the bud and leaf, these canes develop from buds on the previous years growth which in turn are produced on and form the fruit-bearing spurs situated at intervals along the main permanent arm of the vine.

A vine trained in this manner is usually referred to in this State as a "Unilateral Cordon," or a permanent arm with spurs.

A cutting from a grape vine after its first summer's growth could resemble the drawing shown in Plate 120.



Plate 120.

"Muscat" vine, Stanthorpe District, before pruning, 4 years old.

In Plate 121 it appears, after having received its first pruning. It will be noticed that the most upright growing cane has been selected and all other growth has been suppressed. This main cane will form the trunk of the future vine, but it must be shortened back, usually to two or three eyes, in order to encourage a strong growth the following summer, when again an upgrowing cane is chosen and trained with a graceful curve along the first wire of the trellis, which is usually from 20 to 22 inches from the ground, all other growth from the trunk being cut away.



Plate 121.

Same vine after pruning.

The drawing shown in Plate 122 illustrates the young vine after having received the second winter pruning. It will be observed that the main cane has been shortened back along the wire from 1 foot to 2 feet 6 inches according to the vigour of the vine. The end bud should be selected from one placed on the under surface of the cane, the object being to induce the new end growth to lie as flat as possible along the wire instead of growing upwards as would be the case if pruned to a bud on the upper part of the cane. Remove all lateral growth.



Plate 122.
10-year-old "Muscat," Stanthorpe District, before pruning.

The third pruning (see Plate 123) will consist of spacing the canes on the upper surface of the main arm, usually from 6 to 8 inches apart, and pruning them back to two eyes; remove all other growth except the end cane, which is cut back to a length of 1 foot or 18 inches, treating the terminal bud in the same manner as in the previous pruning.

Assuming the vines are planted 6 feet apart and they have made good growth, the fourth pruning should bring each vine up to meet its neighbour.

The spurs established in the previous pruning should each have produced two canes, one from each eye, and in order to retain the spurs as close on to the main arm as possible the top cane is removed and the lower one pruned to two buds as previously, a section of the extreme end growth is left to join up with the next vine.

During the fifth winter the vine is treated in the same manner so far as the spurs are concerned, *i.e.*, keeping only the lower cane which is cut back to two eyes.

The end spur of the vine receives different treatment, a short section of the top cane is laid down to meet up with the first spur of the adjoining vine, while the lower cane is pruned to two eyes forming the return spur which will furnish two canes the following summer that will be treated in the same manner.

The first spur on the main arm should commence on the wire and just past the curve of the trunk.



Plate 123.
Same vine after pruning.

It is a recognised procedure when pruning to cut through the node directly behind the bud, the reason being that in doing so a hard surface is exposed, which is less liable to rot or die back past the end bud as when cut through the internode, *i.e.*, the section of cane between the eyes.

BAGGING OF BANANA BUNCHES ON THE PLANTATION.

P. MITCHELL and E. L. MILES, Inspectors, Diseases in Plants Acts.

THE benefits derived from bagging the bunches are not realised by the majority of banana growers, as it is the general opinion that bagging is carried out only by growers whose plantations are subject to either light frost or severe chilling. Such is not the case, however, as from observations during the past five years it has been ascertained that very definite beneficial results can be obtained by the bagging of the bunches during the whole year.

In the first place it is necessary to point out that there is a distinct difference between the results obtained by bagging and those obtained by "cloaking" or wrapping a bag partly round the bunch. It is quite obvious that a bunch completely enveloped in a bag has more protection than one which is only partially covered, hence the improved results.

The only disadvantages of bagging are—

1. The cost of the bags, and the time required for slipping them on to the bunches; and

2. The extra time required when cutting the fruit, as opening the bags takes a little longer. This latter, however, can in time be practically eliminated, as growers with a little practice can estimate quite accurately whether the fruit is full or otherwise by feeling through the bag.

On the other hand, the advantages of the system are as follows:—

1. The production of fruit superior in length and circumference, and uniform in development and flavour;

2. Uniform colour of all the fruit on the bunch;

3. Greater protection of the fruit during transport to the packing shed;

4. The prevention to a very great extent of loss from sun scorching, splitting of fruit, ravages of caterpillars and spotting bugs, undue exposure, and the spotting of fruit which occurs periodically chiefly in low and damp situations; and

5. Growers are enabled to maintain a better control of leaf spot, as all old and useless leaves can be cut off to assist in such control, there being no danger of the bunch being ruined by exposure to sun and cold. It has been observed during the last five seasons on several plantations where leaf spot has been severe and where bagging has been carried out that, in the case of plants (carrying good bunches) which had been totally defoliated, when these bunches were examined the fruit was of a beautiful green colour, practically without blemish, and consisting of fully 95 per cent. of marketable fruit, whereas without bagging this fruit would have been from 75 to 100 per cent. definite loss.

Very interesting figures have been supplied by Mr. E. L. Miles, Banana Board agent, Palmwoods, in his records of the actual results obtained from the bagging of fruit on Mr. W. Ellison's plantation at Bald Knob, Landsborough. This plantation was situated on a very cold slope, subject to high southerly winds.

Unbagged.—(Bunched middle of February, March, and April, 1933)—

Date Cut.	Total Cases.	Waste.	No of Fruit in Case.
26th Sept.	2	¼ box	28 to 31 doz.
3rd Oct.	5	¾ box	28½ to 32 doz.
17th Oct.	2	¾ box	28¾ to 34 doz.

Bagged.—(Bunched end of March and April, 1933)—

Date Cut.	Total Cases.	Waste.	No of Fruit in Case.
26th Sept.	4	4 bananas	20 to 24 doz.
3rd Oct.	6	11 bananas	19¼ to 20¼ doz.
10th Oct.	2	4 bananas	19¼ to 20 doz.
17th Oct.	3	8 bananas	19 to 20 doz.

All bunches for bagging and control were selected for uniformity in size of fruit and bunch. The "box" referred to as waste in the case of the unbagged fruit was a regulation size butter box; the numbers of waste in the bagged trials were single bananas only.

The above figures are for the winter period. No records are available with regard to summer bagging, but bunches on the same plantation bagged during the spring have been cut in ten weeks. However, the above decrease in the loss of fruit can be expected to be maintained practically throughout the year.

The cost of the bags in the first instance is somewhat high. If good-quality bags are obtained the approximate cost is about £10 per acre, but as an offset to this most of the bags will last for two bunches.

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit Packing.

THE past month has been a bad one for the fruit industry in so far as the weather has been concerned. Cold and rainy weather has reacted adversely on many lines, citrus fruits particularly being affected. With the advent of warmer weather the market for this fruit should pick up and return better prices to growers.

With the winter months, complaints concerning green papaws and pineapples on Southern markets invariably increase. Owing to the cooler weather at this period of the year, there is very little risk attached to sending these fruits to the interstate markets, and they should be allowed to mature and colour to a more advanced stage. Green fruit at this time of the year is practically unsaleable. It is only by sending good lines to the Southern markets that a demand for tropical fruits can be fostered and increased in Melbourne and Sydney.

Pineapples.

Brisbane prices for Smooths ranged from 3s. to 6s. per case, and for Roughs from 3s. to 5s.; loose, Smooths from 2s. to 5s. per dozen, and Roughs from 1s. to 3s. per dozen. Woodwool is recommended for packing in preference to blady grass.

Sydney prices were from 7s. to 10s. per case, and Melbourne from 8s. to 10s.

Green fruit is unsaleable on all markets.

Bananas.

Brisbane prices: Sixes, from 5s. to 10s. 6d.; sevens, from 7s. to 11s.; eights, from 9s. to 12s. 3d. per case.

Melbourne prices: Sixes, 14s.; sevens, from 13s. to 14s.; eights, from 14s. to 15s. Much undersized fruit is being sent in each grade, many cases being marked down. This should be easy to remedy.

Sydney prices: Sixes, from 10s. to 13s.; sevens, from 13s. to 15s.; eights, from 15s. to 17s.

Papaws.

Brisbane prices for locals ranged from 3s. to 5s. a case, and for Yarwun and Gunalda fruit from 6s. to 10s. Sydney prices were from 12s. to 18s. a case; green fruit unsaleable. Melbourne prices were from 10s. to 14s. a case; green fruit is not wanted at Melbourne, and at present too much of this immature fruit is being sent.

Custard Apples.

Half-bushel cases of fruit are bringing in Brisbane from 2s. to 3s., in Sydney from 3s. to 4s. 6d., and in Melbourne from 4s. to 6s. Only fully matured fruit should be sent. Fruit is matured when the interstices show a rich creamy colour.

Avocados.

This popular fruit is finding a readier sale each year. It is recommended to wrap each fruit.

Tomatoes.

Brisbane prices for local ripe fruit were from 1s. 6d. to 4s. a case, and for green fruit from 1s. to 2s. 6d. Attention is again drawn to the

difference between the prices of ripe and green fruit. Sydney prices ranged from 3s. to 4s. 6d., and for repacked fruit from 4s. to 6s. 6d. per half-bushel case; Melbourne prices for repacked fruit to 10s. per case.

The necessity for discarding green fruit must be stressed. It should be possible for the grower to obtain the difference between the ripe and green prices prevailing, as green fruit is bought by speculators who ripen it to their own advantage. Overmuch green fruit on the market gives the speculator every opportunity of working the market to his own advantage.

Other Tropical Fruits.

A good demand still exists for good granadillas. Unfortunately, many lines of fruit have been placed on the market in too green a condition. The fruit can be left to become coloured before marketing without incurring any risk of loss.

Citrus.

The cold weather has had an adverse effect on the local citrus market. Brisbane prices for navel oranges are—for locals, 6s. to 8s., and Gayndah fruit to 11s., with common oranges bringing from 4s. to 7s.

Many lines of mandarins have been badly affected by the cold windy conditions prevailing during the last month, and are not keeping well. The advent of warmer weather should assist the market to rise to better values. Brisbane prices for Emperors are from 3s. to 6s., and for Glens (local) 3s. to 6s., (Gayndah) to 7s. 6d. The end of July saw a rise for good mandarins to 11s. per case.

Good lines of lemons are not hard to sell, but poor uncured skin-blemished fruit is almost unsaleable. Local uncured fruit brought from 4s. to 6s. per case, while Gayndah fruit brought up to 12s. for special lines.

Common types of grapefruit sold to 6s., and good Marsh type to 8s.

Passion Fruit.

Queensland passion fruit realised in Sydney from 7s. to 9s. per half-bushel. Good fruit was readily saleable in Brisbane at up to 8s. per case.

Strawberries.

In Brisbane heavier supplies have somewhat depressed the market, 5s. to 8s. being obtained for average quality, with specials higher. In Sydney the demand in the latter part of the month was slower, some poor-quality lines depressing the market.

Apples.

Granny Smiths sold freely to 13s. per case, with hail-marked fruit 2s. to 3s. lower. Growers with apples in cold storage would now do well to start to remove and place on the market in regular lots. This will enable the agent to work up a connection for good fruit at payable prices.



Plate 124.

MR. S. S. HOOPER, FORMERLY ACCOUNTANT, DEPARTMENT OF AGRICULTURE AND STOCK, who has retired after forty-two years' service.

VALEDICTORY.

Retirement of Mr. S. S. Hooper.

AFTER forty-two years as Accountant of the Department of Agriculture and Stock, Mr. S. S. Hooper closed a notable official career on 30th June. Mr. Hooper entered the Public Service of Queensland in 1886, and became Accountant of the Department in 1894, a position which he filled with distinction.

To mark the occasion of his retirement and to express their personal regard for Mr. Hooper, fully 200 of his fellow officers assembled at a social function on the evening of his last day in the Queensland Public Service. The Departmental Sports and Social Club had charge of the arrangements, and the guest of honour, accompanied by Mrs. Hooper, was received by the President, Mr. H. S. Hunter. An excellent programme, marked by originality, versatility and high musical and dramatic talent, was presented by club members.

In his valedictory address, the Minister for Agriculture and Stock (Hon. Frank W. Bulcock) spoke of Mr. Hooper as a man of great capacity and of strong and enduring purpose, who had rendered invaluable service to his Department and to the State during a long and distinguished career. He expressed sincere regret at the severance of an official association, which he and all others present had appreciated most highly, and congratulated him on his very fine record, and on the exceptionally high standard of efficiency in accountancy which he had maintained throughout his period of office. He had been more than a staff officer to the fifteen Ministers under whom he had served—he was that rare type of public officer who was not only the Minister's accountant, but also his guide and friend. Mr. Hooper had contributed very largely to the success of his Department by his skilful financial administration. No other officer in the Public Service had won higher encomiums from successive Ministers, and only that day he had received a telegram from the Premier (Hon. W. Forgan Smith, LL.D.), then on his way home from his important mission in Great Britain, which read: "Desire take this opportunity of extending to Mr. Hooper on eve of his retirement my good wishes for his future happiness. He was capable and loyal officer of Government for many years, whose services I appreciated to the full. Regards. Forgan Smith, Premier."

Their guest, Mr. Bulcock continued, had enjoyed the rather unusual distinction of repeated references in Parliament to the great value of his services as a public officer. For more than forty years he had attended sittings of the Legislative Assembly to assist his Minister in piloting Departmental Estimates through Committee. This was a record unequalled by any other accountant in the State Service. He was leaving the Public Service with the full knowledge that he possessed the confidence of every one with whom he had come in contact, as well as the high esteem and deep and lasting affection of all his colleagues. The Minister expressed the hope of all present that many long and happy years are in store for Mr. and Mrs. Hooper.

Supporting speeches were delivered by Mr. E. Graham (Under Secretary and Director of Marketing), Professor E. J. Goddard (Dean of the Faculty of Agriculture), and Messrs. H. C. Quodling (General Manager, Agricultural Bank), J. S. Hutcheon, A. R. Henry, J. E. England, H. B. Ball, W. J. Copley, M.L.A., and W. T. Gettons.

On behalf of his staff, Mr. Bulcock presented Mr. Hooper with a handsome testimonial and a pictorial history of the Department in beautifully bound volume form. A brief, appropriate, and happily phrased response was made by Mr. Hooper.



Plate 125.

Mr. William T. Gettons, A.I.C.A., who has succeeded Mr. S. S. Hooper as Accountant of the Department of Agriculture and Stock.



Plate 126.

Officers of the Accounts Branch, Department of Agriculture and Stock.

Back Row: H. J. Evans, J. R. Winders, N. D. Irwin, S. Davis, H. Hooper.

Front Row: E. C. R. Sadler, V. F. J. Bohan (Sub-Accountant), S. S. Hooper (retiring Accountant), W. T. Gettons (Accountant), E. F. Keefer.



Plate 127.

Group of former Officers of the Accounts Branch, Department of Agriculture and Stock, who received their training under Mr. S. S. Hooper.

Back Row: A. A. Salmon (Photographic Section), J. P. Donnollan (Secretary, Queensland Sugar Board), C. Sheehy (Supervising Inspector, Commonwealth Dairy Produce Equalization Committee, and Secretary of the Queensland Butter Board).

Front Row: W. Giles (Accountant, Department of Public Instruction), A. R. Henry (Secretary and Member of the Central Sugar Cane Prices Board), S. S. Hooper (retiring Accountant, Department of Agriculture and Stock), J. S. Hutcheon (Barrister-at-law, and Chairman of the Queensland Cricket Association), W. J. Copley, M.L.A. (Bulimba).

VETERINARY MEDICINES ACT.

ANNUAL REGISTRATION, 1936.

Second supplementary list, to be read in conjunction with lists appearing on pages 282-285 of March Journal and 408-409 of April Journal.

Registrations effected from 20th March to 30th June, 1936.

	Reg. No.
Animal Health Station, Yeerongpilly—	
First and Second Blackleg Vaccin	333
Contagious Mammitis Vaccine	334
Laboratory Pleuro-Pneumonia Vaccine	335
British Germicide Co., Queen street, Brisbane—	
Drenchsol	1227
Butler and Co., Ltd., Edward street, Brisbane—	
Butler's Worm Powder for Dogs	1135
Buzacotts (Qld.) Ltd., 443 Adelaide street, Brisbane—	
Bio Blister Paste	365
Bio Bot Bombs	366
Bio Bowel Laxative for Dogs	1439
Bio Bronchial and Pneumonic Distemper Mixture	1438
Bio Canker Cure	1436
Bio Condition and Kidney Powders	367
Bio Condition Powders for Pigs	368
Bio Cough Electuary	1036
Bio Cough Mixture for Dogs	1428
Bio Eye Powder	369
Bio Flatulent Colic Drench	370
Bio Flukure	371
Bio Fosfodine	372
Bio Gastric Distemper Mixture	1437
Bio Greasy Heel Ointment	373
Bio Greyhound Tonic	1432
Bio Healing Balsam	374
Bio Laxative Drench for Horses	376
Bio Mange Ointment	377
Bio Painidine	390
Bio Prophylactic Cow Drench	379
Bio Scours Remedy	380
Bio Soothing Liniment	381
Bio Spasmodic Colic Drench	382
Bio Special Colic Drench	383
Bio Stock Drench (Liquid)	1034
Bio Titbalm	384
Bio Urine and Diuretic Powders	1037
Bio Uterine Bombs	385
Bio Vaginol	386
Bio Worm Capsules	1433
Bio Worm Drench for Horses	387
Bio Worm Powder for Pigs	388
BWK Bio Worm Killer for Sheep	389
Stewart's Bio Royal Embrocation	392
Stewart's Liquid Blister	393
Chemical and Tar Products Ltd., Lower Ann street, Brisbane—	
Harton Arsenical Sheep Drench	1377
Veto-cide	394
Cramsie, Dwyer, and Co., Wallangarra—	
Cupiss' Aromatic Physic Balls	326
Cupiss' Condition Powders for Dogs	1123
Cupiss' Condition Balls	327
Cupiss' Embrocation	328
Cupiss' Tonic Powders	320
Dog Constitution Pills (Cupiss)	1124
Cray, O. P., 151 Wickham street, Brisbane—	
Puppy Worm Syrup	25

	Reg. No.
Dalgety and Co., Ltd., Brisbane—	
Kerol	822
Hamilton Pty. (Q.) Ltd., 92 Adelaide street, Brisbane—	
Blakemere Alterative Mixture	182
Blakemere Dusting Powder for Dogs	220
Hamilton Fistula Vaccine	257
Hamilton Strangles Vaccine	256
Hamilton Vaccine (Contagious Mammitis)	183
Metacal	250
Nutrimol	266
Pottie's Blackleg Preventive	1267
Pro-Vet Antiseptic Capsules	184
Pro-Vet Antitoxic Drench	185
Pro-Vet Blackleggine	414
Pro-Vet Black Spot Application	186
Pro-Vet Blighty	187
Pro-Vet Bloat Draught	188
Pro-Vet Calcium Drench	189
Pro-Vet Canine Skin Dressing	415
Pro-Vet Canine Distemper Vaccine (A and B)	190
Pro-Vet Cleansing Drench	191
Pro-Vet Colic Remedy	192
Pro-Vet Condition Powder	416
Pro-Vet Cough Electuary	193
Pro-Vet Diuretic or Staling Powder	194
Pro-Vet Dog Mixture	1262
Pro-Vet Eczema Cure	253
Pro-Vet Embrocation	221
Pro-Vet Emulsion for Cracked Heels	195
Pro-Vet Foot Rot Paste	196
Pro-Vet Gall Cure	222
Pro-Vet Harness Chafe Application	223
Provetine	197
Pro-Vet Laxative Drench for Horses	417
Pro-Vet Liquid Blister	267
Pro-Vet Mange Specific for Horses	272
Pro-Vet Pan-A-Ton	199
Pro-Vet Physic Balls for Horses	268
Pro-Vet Pig Powders	254
Pro-Vet Salve	201
Pro-Vet Scour Remedy	202
Pro-Vet Speedo Tonic for Dogs	203
Pro-Vet Stock Drench	255
Pro-Vet Tonic Powder for Horses	204
Pro-Vet Udderlin	205
Pro-Vet Vaginitis Cure	206
Pro-Vet Worm Mixture for Dogs	207
Pro-Vet Worm Powder for Horses	224
Sheeptone	1265
Vermort	1057
Vetnol	395
Happidog Pty. (F. David), Queen street, Brisbane—	
Happidog Alterative Mixture	339
Happidog Puppy Worm Syrup	340
Happidog Trumpit Distemper Mixture	341
Hayes Veterinary Co., Ltd., 351 Queen street, Brisbane—	
Aloetic Ball (Wyleys Ltd.)	276
Cutter Blackleg Antigen	263
Havcol	323
Lovelock and Co. Pty., Ltd., W., Roma street, Brisbane—	
Day, Son, and Hewitt's Black Physic Balls	294
Day, Son, and Hewitt's Broncholine	295
Day, Son, and Hewitt's Colonial Red Drench	307
Day, Son, and Hewitt's Curdolix	297

	Reg. No.
Day, Son, and Hewitt's Diuretic Balls	298
Day, Son, and Hewitt's Easakoff	299
Day, Son, and Hewitt's Eye Wash	300
Day, Son, and Hewitt's Gall Ointment	301
Day, Son, and Hewitt's Gaseodyne	302
Day, Son, and Hewitt's Gaseous Fluid	303
Day, Son, and Hewitt's Globe Disinfectant	304
Day, Son, and Hewitt's Kossolian Blood Salt—Farm	305
Day, Son, and Hewitt's Kossolian Blood Salt—Racehorse	306
Day, Son, and Hewitt's Non-Poisonous Worm Pellets	315
Day, Son, and Hewitt's Red Paste or Condition Balls	308
Day, Son, and Hewitt's Red Worm Mixture	309
Day, Son, and Hewitt's Udder and Sore Teat Salve	310
Day, Son, and Hewitt's Universal Brown Chemical Extract	296
Day, Son, and Hewitt's Universal White Chemical Extract	313
Day, Son, and Hewitt's Vetalenta	311
Day, Son, and Hewitt's Wart Solvent	312
Day, Son, and Hewitt's Worm Balls	314
Day, Son, and Hewitt's Worm Powder for Horses, &c.	322
Day, Son, and Hewitt's Xemos	316
Maclean and Co., D., Elizabeth street, Brisbane—	
Baxter's Alterative Mixture	401
Baxter's Distemper Capsules	402
Baxter's Eczema, &c., Lotion	403
Baxter's Kidney and Bladder Pills	405
Baxter's Puppy Worm Syrup	406
Baxter's Red Tonic	407
Baxter's Skin and Blood Pills	408
Baxter's Stomach and Bile Pills	396
Baxter's Tasteless Condition Powders	397
Martin, B., Charlotte street, Brisbane—	
Timid Joe Dog Tonic	1442
Timid Joe Worm Syrup	1441
Moase, W. E., Wynnum—	
Alterative and Condition Powder	350
Moase's Famous Antiseptic Disinfectant Deodorant	351
Moase's Famous Blister—The Ideal	352
Moase's Famous Dairy Ointment	353
Moase's Famous Diarrhœa or Scour Mixture	354
Moase's Famous Draught for Horses or Cow (Colic)	355
Moase's Famous Drench for Cattle	356
Moase's Famous Eye Specific	357
Moase's Famous Liniment	358
Moase's Famous Ointment for Hard Udders	359
Moase's Famous Special Liniment	361
Moase's Famous Specific for Worms in Calves, Sheep, &c.	360
Nicol Chemical Co. Pty. Ltd., 2 Wickham street, Brisbane—	
Nicol's White Oil Embrocation	1075
Noble and Sinnamon, W. A., Ruthven street, Toowoomba—	
Noble's Colic and Gripe Drench	1391
Noble's Dairy Ointment	1390
Noble's Non-Irritant Fluid Blister	1392
Outridge Chemical Co., Wondai—	
Burnett Worm Drench Powder for Sheep	164
Poultry Farmers' Co-operative Society Ltd., Roma street, Brisbane—	
Merval	1122
Red Comb Vaginitis Powder	1368
Ralston, A. V., Brisbane—	
Vardonia	277

	Reg. No.
Row and Co., East street, Rockhampton—	
Row's Alterative, Diuretic, and Condition Powder for Horses	219
Saunders, J. R., Beerwah—	
San Quentin Ointment	474
Sharkey, S. B., 100 Hill street, Toowoomba—	
Bot and Worm Expeller	424
S. B. Sharkey's Special Physic	425
Smith, H. F., Dundorah—	
Co-Lak	1119
Surgical Supplies Ltd., Queen street, Brisbane—	
A.B.C. Canker Lotion	1304
A.B.C. Tasteless Condition Powders	1234
A.B.C. Worm Mixture	1305
Garget Powder	1050
Warwick Friendly Societies' Dispensary, Warwick—	
Turner's Sheep Drench	1274
Wilkinson (Northern) Pty. Ltd., L. A., Queen street, Brisbane—	
Dog Worm Capsules	287
L.P. Embrocation	281
Vetsalve	282
Wilkinson's Canker Lotion	283
Wilkinson's Cleansing Drench	284
Wilkinson's Condition Powder	293
Wilkinson's Distemper Capsules	285
Wilkinson's Dog Tonic	286
Wilkinson's Eye Ointment for Dogs	288
Wilkinson's Laxative Dog Syrup	289
Wilkinson's Mange Lotion for Dogs	290
Wilkinson's Poultry Tonic	291
Wilkinson's Worm Powder	292

QUEENSLAND SHOW DATES.

SEPTEMBER.	OCTOBER.
Tully, 11 and 12.	Gympie Bushmen's Carnival, 7 and 8.
Innisfail, 18 and 19.	Maryborough Bushmen's Carnival, 10 and 12.
Malanda, 30 September and 1 October.	Bundaberg Bushmen's Carnival, 17 and 19.
Southport, 26.	
Imbil, 4 and 5.	
Pomona, 11 and 12.	
Beenleigh, 18 and 19.	

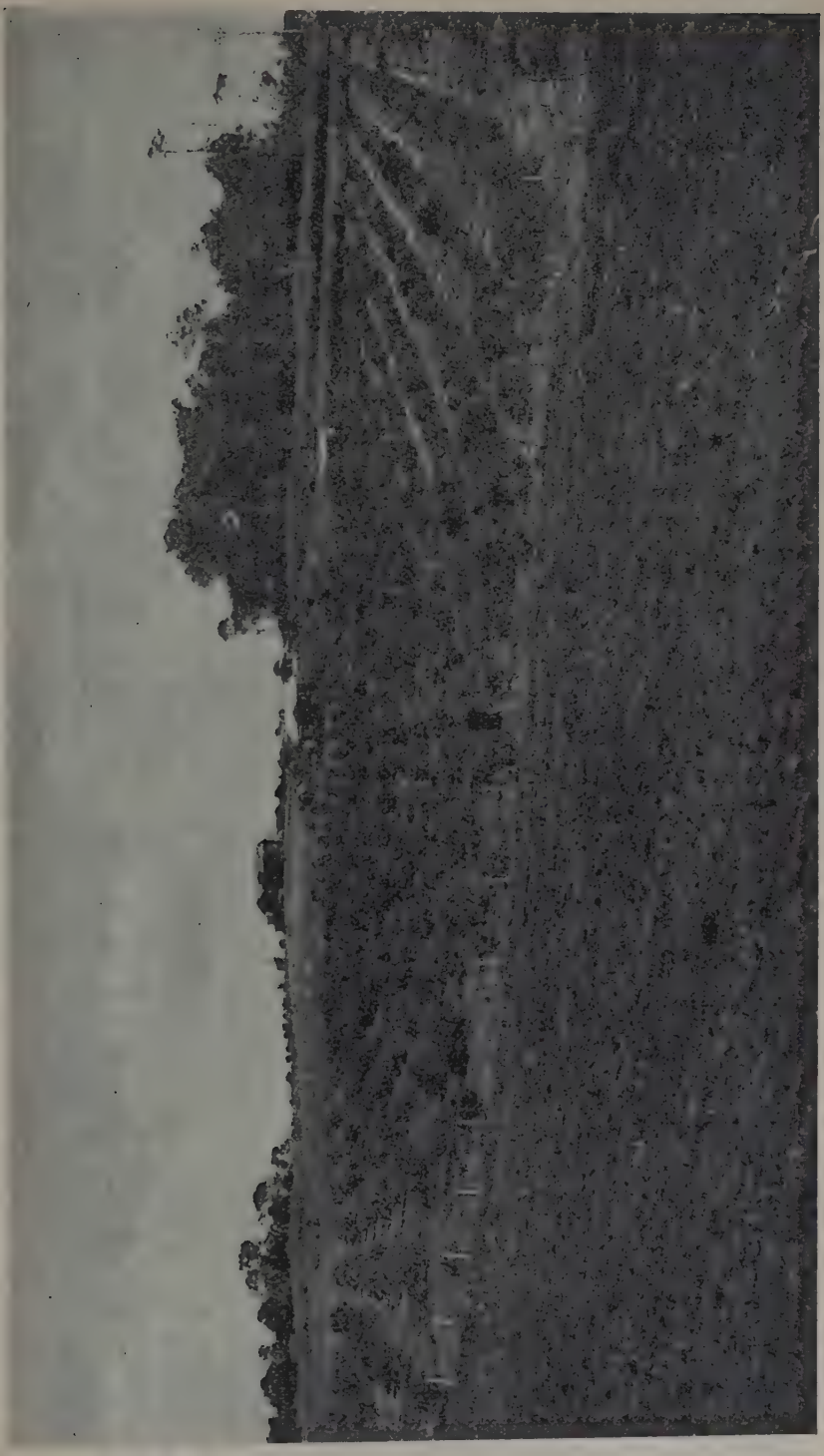


Plate 128.

Citrus Orchard, Tamborine Mountain.—Tamborine is a richly-soiled rain forest plateau, 2,000 feet above sea level, and within a little more than an hour's run of Brisbane.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advance Register of the Herd Books of the Jersey Cattle Society and the Australian Illawarra Shorthorn Society, production charts for which were compiled during the month of June, 1936 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
	JERSEY.			
	MATURE COW (OVER 5 YEARS), STANDARD 350 LB.			
Majestic Queen	W. S. Conochie, Sherwood	10,119·04	564·409	His Majesty of Dalebank
	JUNIOR, 4 YEARS (UNDER 4½ YEARS), STANDARD 310 LB.			
Oxford Dainty 3rd	E. Burton and Sons, Wanora	6,463·25	381·722	Trinity Ambassador
	JUNIOR, 3 YEARS (UNDER 3½ YEARS), STANDARD 270 LB.			
Newhills Dolly's Chance	J. Nicol Robinson, Maleny	4,621·1	281·835	President of Brooklodge
	SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD 250 LB.			
Dawn Victors Betty	A. L. Walker, Dawn, Mary Valley Line	5,609·7	328·745	Retford Glory's Victor
Nimbrae Esther	F. Nimmo, Rosewood	4,928	277·763	Oxford Tressadore
G.N. Conlisse 4th	Cox Bros., Maleny	4,019·7	264·908	Retford Royal Atavist
Cabulcha Milruth	J. M. Newman, Caboolture	5,037·3	258·328	Grasmere Autocrat
	JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD 230 LB.			
Strathblane Little Wonder	F. Maurer, Darra	7,223·25	388·35	Rosecliff Mariposa
Cabulcha Melasol	J. M. Newman, Caboolture	4,808·5	259·851	Pymble Twilights Paragon
Trinity Dreaming Cinderella (242 days)	G. Harley, Childers	5,383·6	247·388	Trinity Dreaming Pioneer
Carnation of Sunnyview	A. Geritz, Goomeri	4,853·85	233·504	Golden Nobly of Hillview
Patience of Calton	A. Geritz, Goomeri	4,494·8	230·111	Retford Meteor

AUSTRALIAN ILLAWARRA SHORTHORN.

Mature Cow (over 5 Years), Standard 350 lb.

Wunulla Ultimate	A. M. Johnson, Gracemere	10,976·3	436·354	Ryes Toga of Wunulla
Lassie 2nd of Kia Ora	Mrs. J. Weber, Peak Crossing	10,188·25	381·92	Red Knight of Greyleigh
Kia Ora Duchess	Elliott Bros., Kia Ora, Goomboorian, Gympie	8,364·2	371·939	Principal of Blacklands

Senior, 3 Years (over 3½ Years), Standard 290 lb.

Corunna Stripes	G. Gwynne, Umbiram	7,128·56	329·158	Corunna Bruce

Junior, 3 Years (under 3½ Years) Standard 290 lb.

Chilmer Flower	W. G. Marquardt, Wondai	10,503·8	447·845	Thornleigh Lockinvar
Trevor Hill Bluebell	G. Gwynne, Umbiram	9,572·37	375·973	Viceroy of Wilga Vale
Rhodesview Primrose	W. Gurke and Sons, Helidon	7,853·68	302·286	Blacklands Prospector

Senior, 2 Years (over 2½ Years), Standard 250 lb.

Glenore Dairymaid	A. M. Johnson, Gracemere	10,149·65	394·7	Sunnyview Jncle Jack
Blacklands Flower 9th	A. Pickels, Wondai	8,384·15	337·757	Fussy's Monarch of Hillview
Rhodesview Beauty 9th (260 days)	W. Gurke and Sons, Helidon	8,523·37	330·695	Blacklands Prospector
Mountain Home Gem 11th	M. C. Lester, Laidley Creek	6,674·53	277·734	Mountain Home Don
Rhodesview Gypsy 11th	W. Gurke and Sons, Helidon	7,784·30	275·835	Blacklands Prospector

Junior, 2 Years (under 2½ Years), Standard 230 lb.

College Gold 2nd (365 days)	Queensland Agricultural High School and College, Gatton	13,965·14	557·766	Premier of Hillview
Palmetts Coquette	Rex Tweed, Kandanga	8,293·1	347·559	Glengallan Major
Millstream Beryl 3rd	W. J. Barnes, Cedar Grove	8,081·35	311·948	Oakvale Captain
Millstream Meg 3rd	W. J. Barnes, Cedar Grove	7,841·58	286·135	Oakvale Captain
Glenore Myrtle	Mrs. E. B. Graham, Goomeri	6,590·5	255·186	Sunnyview Jnion Jack
Blacklands Fancy 6th	A. M. Johnson, Gracemere	6,886·4	244·373	Emperor of Blacklands

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Report on specimens collected by Inspector Walker in connection with deaths of sheep, Quilpie district:—

1. *Sida corrugata.*—This is one of the plants suspected of causing paralysis in sheep in Cunnamulla district. See report by Hodge and Francis, "Queensland Agricultural Journal," July, 1932.
2. *Solanum esuriale.*—Potato Bush. Not known to be poisonous.
3. *Indigofera enneaphylla.*—A wild Indigo.
4. *Trianthema crystallina.*—A plant allied to the pig weeds, very common in Western Queensland, and generally regarded as a useful fodder herb.
6. *Cassia desolata.*—Not known to be harmful. Like other Cassias, it might act as a purgative if eaten in any quantity.
7. *Trichinium obovatum.*—A plant of the Amaranth family. Practically all members of this family are harmless, and more or less useful fodders.
8. *Psoralea* sp.—Species of Psoralea are generally regarded as useful fodders.
9. *Malvastrum spicatum.*—This is one of the plants suspected of causing paralysis in sheep in Cunnamulla district. See report by Hodge and Francis, "Queensland Agricultural Journal," July, 1932.
10. *Kochia* or *Enchylæna.*—Saltbush family. Fruit required to determine. Not likely to be harmful.
11. *Alternanthera denticulata.*—A plant of the Amaranth family, generally regarded as a useful fodder.
12. *Tetragonia expansa,* "New Zealand Spinach."
13. *Myoporum acuminatum.*—May be harmful if eaten in quantity.
14. *Euphorbia Drummondii.*—Creeping Caustic. Causes swelling of head and neck. Occasionally this plant is cyanogenatic, and may cause prussic acid poisoning.
15. *Minuria integerrima.*—A plant of the Daisy family, very common in Western Queensland and not known to be harmful or poisonous in any way.

Central Western Plants Identified.

J.F. (Longreach)—

1. *Eragrostis cilianensis.* Stink grass. This grass is so named on account of the peculiar odour emitted by glands on the leaf edges. It is usually left untouched by stock, but we have a record of horses eating it when ploughing, but this is hardly a normal condition.
2. *Echinochloa colona.* Wild millet. This is quite a common grass which is more frequently found as a weed of cultivation, in damp situations, &c., rather than in the ordinary pasture. It is quite a good fodder being allied to and probably one of the wild parents of such well known crops as Japanese millet and white panicum.
3. *Chloris virgata.* Feather top or feather topped Rhodes grass. This grass is widely spread over the sub-tropical regions of the world and is quite common in parts of Queensland. It occurs mostly as a weed of cultivation or where the ground has been disturbed rather than in the ordinary pasture. Generally speaking stock do not seem to care for it, although we have had occasional reports to the contrary. Stock seem to eat it readily enough in the form of hay, however.
4. *Sporobolus elongatus.* Rat's tail grass.
5. *Sarcostemma australe.* Caustic vine. This has been proved to be poisonous to stock by feeding experiments.

Asthma Plant.

F.E.I. (Nerang)—

The specimen is *Euphorbia pilulifera*—Asthma plant. This plant is dried and used to give relief in asthma. It is made the same way as ordinary tea, usually allowed to go cold, and a wine glass full taken for a dose.

Northern Plants Identified.

L.J.W.T. (Townsville)—

Your specimens have been determined as follows:—

1. *Hackelochloa granularis.*—We have not heard a common name for this grass. It should be quite a good fodder. We are very glad to get these specimens, as we have had little native material in the herbarium in the past, most of our specimens coming from New Guinea and further afield.
2. *Trichinium macrocephalum.*—A plant of the Amaranth family. We think most trichiniums are generally regarded as quite good fodders. The purple one is a beautiful plant and at present very common in some of the Western pastures. It is well worthy of garden culture.
3. *Eragrostis australiensis.*—A love grass. This, as you say, is the same as the species on Moreton Island, but most of the Northern plants seem to be of weaker growth.
4. *Iseilema vaginiflorum,* one of the Flinders grasses.
5. *Sporobolus australasicus.*—Very common this year in many of the Western pastures. It is one of the grasses sometimes known as fairy grass.

A Chloris Grass.

G.F.H. (Bobawaba, Bowen Line)—

The specimen represents *Chloris barbata,* a grass widely spread over the tropical regions of the world, generally regarded as a native of tropical America, but now spread elsewhere. It is doubtful if it is a native of Queensland, though it is extremely common. It is closely allied to the Rhodes grass, which is *Chloris gayana,* but is not such a good fodder. We have had various reports about it; most farmers are condemning it, but we have seen it eaten quite freely, especially when kept moderately short by burning or mowing.

Needle Burr.

G.H.L. (Gympie)—

The specimen is the Needle Burr, *Amarantus spinosus,* a common tropical weed that has been naturalised in Queensland over a number of years. It is very common in the North, but is only rarely seen in the more southern parts of the State. Although it seems to grow quite well in southern parts it does not seem to spread to anything like the extent it does in the North. It is not known to possess any poisonous or harmful properties, and like other members of the Amaranth family the young shoots are sometimes eaten, particularly by Asiatics, as a substitute for spinach. We have not tried this particular species, but have tried other amarantaceous weeds in Queensland and found them quite palatable.

An Etna Creek subscriber.—

Your postal note for 3s. (three years' subscription to the Journal) was received on 4th July, but you omitted to add your name to the renewal form. Kindly send your full name and address (written preferably in *block letters*) in order that you may be credited with the amount received.

General Notes

Staff Changes and Appointments.

Mr. R. Veitch, B.Sc., Chief Entomologist, Department of Agriculture and Stock, has been appointed also Director of Research.

Mr. L. F. Mandelson, B.Sc. (Agric.) (Sydney), Pathologist, Department of Agriculture and Stock, has been appointed Agricultural Research Officer.

Mr. C. H. P. Defries, Acting Instructor in Agriculture, has been appointed Instructor in Agriculture, Department of Agriculture and Stock.

An Order in Council has been issued under the Animals and Birds Acts declaring Glendalough Station, Hughenden, to be a sanctuary for the protection of native animals and birds. Mr. McA. Eather, of Glendalough, has been appointed an honorary ranger for this sanctuary.

Mr. J. S. Bramley, of The Gap, Ashgrove, has been appointed an honorary ranger under the Animals and Birds Acts; and Mr. V. Purnell, North Tambourine, an honorary ranger under the Native Plants Protection Act.

The following Forest Officers have been appointed honorary rangers under both the Animals and Birds Acts and the Native Plants Protection Act:—

Messrs. A. G. Smedley (State Forest Reserve, Stapylton), M. R. Jackson, A. Wallace, R. McDowall, J. T. Owen (Forests Office, Beerwah), T. Nicholls, D. A. O'Donnell, W. A. Lacey, G. H. Madsen, F. L. Crain, H. V. Allen, J. F. Marshall, G. Ferrar, A. B. Pearce (Forests Office, Maryborough), W. H. Geissler, L. McGann, and G. Hall (Forests Office, Fraser Island).

Mr. F. A. L. Jardine, Inspector, Diseases in Plants Acts, Stanthorpe, has been appointed also a collector of royalty under the Animals and Birds Acts.

Mr. A. R. Henry, Secretary of the Central Sugar Cane Prices Board, has been appointed temporary chairman of the Central Board on all occasions when the chairman, Mr. Justice Webb, is absent.

Messrs. G. H. Bomford, H. S. H. Wills, J. J. Gerhart, and G. Fisher, of Springsure, have been appointed honorary rangers under the Animals and Birds Acts and the Native Plants Protection Act.

The following transfers of Inspectors in the Department of Agriculture and Stock have been approved:—Messrs. A. F. H. D. Singh, Stock Inspector, from Wondai to Chinchilla; J. Wyvill, Stock Inspector, from Kingaroy to Wondai; J. P. Dowling, Stock Inspector, from Gayndah to Kingaroy; J. Davies, Dairy Inspector, from Chinchilla to Gayndah; A. F. Moodie, Stock Inspector, from Clermont to Mackay; W. A. Kearney, Stock Inspector, from Mount Isa to Clermont; and D. C. Clifford, Stock Inspector, from Brisbane to Mount Isa.

Honorary Rangers under the Animals and Birds Acts have been appointed as follows:—Messrs. V. Purnell (North Tambourine), D. N. Henricks (Rosedale), L. L. Bryant (Victoria Estate, Ingham), and D. G. Smith (Victoria Mill, Ingham).

Constable R. J. Dixon, St. Lawrence, has been appointed also an Inspector under the Slaughtering Act.

Protection of Rhododendron Lochae.

An Order in Council has been issued under "*The Native Plants Protection Act of* 1930" declaring that the native plant *Rhododendron Lochæ* shall be protected throughout the whole State for an unlimited period.

Re-issue of Dairy Produce Regulations.

Executive approval has been given of the revocation of all regulations under the Dairy Produce Acts and to the issue of new regulations thereunder. The regulations have been revised and brought up to date in accordance with recent amendments of the Dairy Produce Acts.

"A B C of Queensland Statistics."

A copy of the 1936 issue of the "A B C of Queensland Statistics" has been forwarded to us by the Government Statistician.

This issue follows the general lines of previous issues, but certain new matter has been introduced. New tables show financial assistance to the States by the Commonwealth Government, interstate trade and total external trade of Queensland, the Queensland business index (with a graph), share prices index, and traffic accidents. Data concerning production (primary and secondary), labour and industrial matters, vital statistics, &c., are included. The revisions and additions carry on the progressive improvements of recent years, and will be continued with the object of informing the public of Queensland as fully as possible each year of the evidence collected through its statistics.

A few important figures are:—

Population, &c.—The population of Queensland steadily increases, and at the 31st December, 1935, it was 970,723. The birth rate for 1934 was the second highest, whilst the death rate was the lowest in Australia.

Livestock and Wool.—At 1st January, 1935, there were 6,052,641 cattle, 21,574,182 sheep, and 269,873 pigs in the State, each of these figures being an increase on the previous year. The wool production for 1934-35 amounted to 174,088,413 lb. (greasy), and was valued at £7,587,353, an increase in the production but a decrease in the value, owing to lower wool prices.

Agriculture and Dairying.—The total value of agricultural produce for 1934 was £11,905,806, a decrease from 1933. The production of cotton and maize was increased, but wheat and sugar showed decreases. The 1934 output of factory and farmers' butter was greater than that of 1933 by approximately 20,000,000 lb.

Mining.—The values of gold and tin obtained in 1934 were considerably higher than those of 1933. The total value of production was £2,281,000, a small increase on 1933.

Trade.—Combining Queensland overseas trade with the interstate figures, imports in 1934-35 were £25,396,000 and exports £31,290,000. Imports increased by £3,500,000 on 1933-34, while exports showed a decline of £1,500,000.

Unemployment.—The percentage of Queensland men wage and salary earners unemployed during 1935 averaged 11.0, compared with 15.1 in 1934 and 22.8 in 1931. The 1929 percentage was 10.1. The figures take account of the full-time equivalent of relief work.

This publication, of convenient size, should be of use and interest to all those desiring the latest information concerning the State. The price is only 2s. (post free), and it may be had upon application to the Government Statistician's Office, Treasury Buildings, Brisbane, or at any of the leading booksellers.

Protection of Native Plants on Friday Island, Torres Strait.

An Order in Council has been issued in pursuance of the provisions of "*The Native Plants Protection Act of* 1930," declaring Friday Island, Torres Strait, to be a district for the purposes of the Act. A further Order in Council declares certain native plants which shall be protected throughout Friday Island.

Darling Downs Fruit Districts.

Proclamations have been issued under the Diseases in Plants Acts adding to the list of fruit districts already declared under such Acts a description of the Warwick fruit district, and altering that of the Darling Downs fruit district. Further, it is notified that certain weeds and grasses growing within a distance of 1 yard from the trunk of each fruit tree in orchards in the Stanthorpe and Warwick fruit districts shall be pests within the meaning of the Acts, and directing that such pests shall, from October in each year to January following, be eradicated. Owners or occupiers of orchards in these districts are directed to take the necessary action to remove such weeds and grasses.

Regulation No. 30, made on the 16th November, 1933, relative to the spraying of deciduous fruit trees in the Stanthorpe fruit district, has been amended so as to apply to the Stanthorpe and Warwick fruit districts.

Northern Plywood and Veneer Board.

An Order in Council has been issued in pursuance of the provisions of the Primary Producers' Organisation and Marketing Acts extending the operations of the Northern Plywood and Veneer Board until the 2nd May, 1939.

Removal of Sugar-cane Plants in Mulgrave District Prohibited.

Executive approval has been given to the issue of a Proclamation under the Diseases in Plants Acts which rescinds a Proclamation issued on the 4th April, 1935, and declares a quarantine area under the Acts to include portions of the parish of Sophia, Mulgrave district. The nature of the quarantine to be imposed in this area shall be the prohibition of the removal from and the planting or replanting in the area mentioned of certain varieties of sugar-cane, except for the purpose of milling at the Mulgrave Sugar Mill, unless a permit shall have first been granted by an Inspector. The quarantine area is slightly larger than that declared last year.

Banana Planting Policy 1936-37.

It was announced at the Department of Agriculture and Stock recently in further amplification of the planting policy of the Banana Industry Protection Board for the coming season, that growers wishing to plant new areas or extend their present plantations must apply to the secretary of the Board for permission to do so.

In general it could be taken that a permit would not be granted to the owner of a neglected plantation, nor for planting in close proximity to a plantation badly affected with Bunchy Top. In the quarantine area, generally referred to as the buffer area, comprising the parish of Mooloolah and portions of the parishes of Bribie and Maroochy, special conditions applied. Unless the Board specially approved, no permit would be issued for any new plantings in the quarantine area, which would bring the total acreage under bananas for any one owner in excess of 8 acres.

The Flying Fox Pest.

The Minister for Agriculture (Hon. F. W. Bulcock, M.L.A.), commenting on a report from the Director of Fruit Culture (Mr. H. Barnes) on the serious damage by flying foxes to citrus orchards in the Rockhampton, Burrum, and Gayndah districts, stated:—The pest is undoubtedly a difficult one to cope with. Its chief food is the blossom of native gum and other wild bush trees, and it is very fortunate for orchardists that it is only in occasional seasons of shortage of wild blossoms that the foxes seriously attack commercial fruit trees. Practically all classes of fruit are attacked at times, and it is a fact that more damage is occasioned by the amount of fruit knocked off the trees and the breaking of the smaller branches than in the quantity of fruit actually consumed.

Some fruits, particularly mangoes, are very subject to damage each season, and this is no doubt due to the strong scent given off by such fruits when ripening.

Many millions of foxes exist throughout Queensland and New South Wales, and so far no economic means of extermination has been found. There are several different species, but probably the worst is the grey-headed fox.

In 1929 and 1930 the Queensland and New South Wales Governments contributed funds towards an investigation of the flying fox problem in co-operation with the Council for Scientific and Industrial Research, and Mr. F. N. Ratcliffe, B.A., was engaged to make a survey of the position. Mr. Ratcliffe, in his report issued in 1931, mentioned that various methods of destroying the foxes had been tried out. In the first place he stated that the numbers of flying foxes in Australia are so vast and their range extends so far outside the limits of close settlement that a system of general control based on the direct destruction of the animals must be ruled out as a physical and economic impossibility. The only hope of general control lies in the possibility of indirect destruction by biological means. Attempts have been made by one or two scientists to introduce epidemic diseases, but unsuccessfully.

The question at the moment then appears to boil down to protection so far as possible of his own orchard by the individual grower. In this regard only one method appears on experience to be in any way effective, and that is by the use of poison baits. It is recommended reluctantly because there is a risk where children and animals are allowed to roam the orchard. Where the orchard is attacked by foxes it will be observed that many ripe fruits are only partially eaten, and it is a fact that when such fruit is available the foxes will return to it again. If these fruits are dusted with powdered strychnine and wired on to the branches near the top of the trees some of the foxes will be poisoned. It has been noticed that in an orchad where a number have been poisoned in the course of a few nights the animals in future cunningly avoid that particular orchard. The use of scarecrows, lights, &c., is of no value, as the foxes quickly become used to their presence, and seem to sense no danger from them.

The use of poison gas, also, has been tried out as a means of mass destruction, but the results were ineffective.

Rural Topics

Udder Complaints in Dairy Cows.

Thus "Himi" in the "New Zealand Farmer":—

Perhaps the most fruitful topic of conversation amongst dairy farmers is the various forms of udder complaints. The present trend in milk and butter-fat prices makes it imperative to eliminate every possible source of waste or inefficiency in production, and as teat and udder troubles occur chiefly among cows in milk—the heavy-yielding animals being most susceptible—losses from these diseases may be very serious, especially as they may be permanent. The proper attitude to adopt in all udder troubles is to regard all of them as contagious, and to deal with them as a possible channel of infection for a general mastitis, or inflammation of the udder, for even simple teat injuries caused by accidents may be the starting point of pus infection and may develop into milk sinuses. Teat injuries must be dealt with in accordance with their nature, but under all circumstances strict cleanliness and antiseptic measures should be employed. If syphons are used they should be thoroughly sterilised; failure to do this is one of the commonest causes of udder trouble following on teat injury. It should be remembered that teats which have weak sphincter muscles, and which allow the milk to leak out of the teat when the udder is full—which means frequently that there is a drop of milk hanging to the end of a teat—are very liable to teat and udder inflammation. All sore or swollen teats should be washed carefully before milking or stripping with some warm, non-irritant disinfectant, such as a 3 per cent. solution of carbolic acid or a 2 per cent. solution of lysol, and after milking they should be dried and rubbed over with boracic acid ointment. A separate milker should handle all cases of sore teats and udders.

New Zealand's Dairy Herds.

Australian dairymen will do well to note the steps taken by milk cattle interests in New Zealand in developing the industry to the remarkable proportion that it has attained during the last decade. A dozen years ago the average butter-fat yield of cows pastured in the Dominion was 154.25 lb. The figure to-day is 250 lb. to 275 lb. a cow, with the heaviest yielders giving 375 lb. or over. Eighty per cent. of the production which nets the Dominion £11,649,000 in a year for butter export and £4,766,000, in addition, for cheese export, is from the North Island, and over the 5,000,000 acres of specially nurtured pasture devoted to dairying the 75,000 herds average twenty-four cows in herd strength. The New Zealand dairy farm is not extensive, the average holding being round about 120 acres. The most recent classification of the dairy breeds in the Dominion shows Jerseys to constitute 63.3 per cent. of the 287,000 cows under test, Milking Shorthorn 22.1 per cent., Friesian 12 per cent., and Ayrshire 2.6 per cent. More recently the number of Jersey or grade Jersey cows has very substantially increased, and it is now estimated that the Jersey strain predominates to the extent of 80 per cent. of all dairy cattle maintained. The declared reason for the breed's popularity is that as the Jersey is comparatively a small-build type, the herd owner is able to carry a larger number of cows in milk an acre, added to which he is assured, on satisfactorily responding land, of individual and collective high butter-fat production, while at the same time he is stocking his limited acreage range with an early maturing class of milking animal. An especially significant point is that practically invariably the New Zealand herd is headed by a specially chosen high-class bull in keeping with the commonly shared deliberate policy of maintaining the highest possible production standard. Unutilised patches of ground are hard to come across, and, on the contrary, density of herbage is the chief dairy holding characteristic. In districts subject, during the winter months, to frost and rigorous conditions, a pasture mixture of perennial rye-grass and white clover is depended on. Where the climate is less severe, paspalum finds its place with these pasture ingredients, and in other pasture mixtures, cocksfoot, crested dog's tail, and red clover find their place. Topdressing is almost exclusively in the form of superphosphate, heavy dressings averaging 3 cwt. to the acre, with more lavish distributions up to 6 cwt. or even 7 cwt. to the acre being applied both in spring and autumn.—"The Australasian."

Immigration.

It is not by economic criteria that national policy is or should be determined, and the promotion of immigration is one of those policies in which the question of cost is subordinate. Nevertheless it is proper that the economic limitations should be stated. Queensland has had an experience of over seventy-five years with this policy, and its limitations have been repeated many times. There is no field of Government "interference" where the economic conditions are so plain and the limitations so immediate in their effects. This, no doubt, is because action which moves population affects the economic life of the people more directly than action which regulates trade, or production, or industrial conditions. The aspirations of national or imperial policy, the merits, the desirability, and even the urgency of securing more people are none of them in question.

Pre-Depression Principles.—It is not necessary to go far back to discover the conditions for successful immigration. During the pre-depression years Australian immigration policy was governed by the slogan "Men, Money, and Markets." In those years there was no anticipation of any limited market in Great Britain. The price protection given to our products was disappointing, but more was hoped for. The men and the money were to be provided under an agreement between the British and Australian Governments. This agreement also proved to be disappointing, but it recognised in principle the connection between the two things. Periods of active immigration have always been periods of active investment from oversea, as a rule in Government loans. In effect the agreement provided for a small British subsidy in aid of interest. The subsidy was much less than the savings to be made by British relief authorities, and was based on a capital sum of only £75 per immigrant actually settled. The agreement had no effect on events.

Experience.—The boom period was the eight years 1922 to 1929, and it lasted as long as oversea borrowings continued. Australian population and oversea debt were alike swollen. Some parts of each—probably the greater parts—were additions within our normal capacities. The balances would have been net liabilities even if the world depression had not supervened, for such had been prior experience.

In 1929 the spending of oversea loans was exhausted and net immigration fell to 11,892. In the next three years there was a net *emigration* of 21,441. During the last three years net immigration has totalled about 5,000.

An immigrant, like a debt, may or may not create an equivalent asset. Both create liabilities. Human necessities go on as insistently as a contract for interest.

"Men and Money."—The following table gives (for Australia) the immigration of persons and of capital on Government loan account in the boom years, and also on the increase in oversea debt per head of population. The last column shows the rising debt per immigrant, but not the amount spent on immigrants. There was private investment also from oversea. On the other hand, some of the oversea capital went to increase the incomes of the native-born.

Immigration and Oversea Debt.

Period.	Net Immigration.	Increase in Oversea Debt.		
		Total.	Per Head of Population.	Per Immigrant.
		£ millions.	£ s. d.	£
Four Years—				
1922-3-4-5	165,968	92	9 19 10	554
1926-7-8-9	138,512	108	11 8 2	780
Eight Years	304,480	200	21 8 0	657
Average per Year	38,060	25	2 13 6	657

In the same period internal debt increased by £75 millions, total Government interest increased by 47 per cent., and taxation increased by 30 per cent.

It would be a reasonable deduction from the evidence that immigration during the period depended on oversea loans to the extent of about £500 per immigrant, rising from £400 to £600.

Limitations.—There are no limitations imposed on British immigrants, but only on the scope of subsidised passages, and new public oversea loans are suspended. Both limits are chiefly political and may be removed, but the economic limits are:—

(*a*) The relief employment still prevailing;

(*b*) The self-defeating effects on development of increases in taxation;

(*c*) The fact that a lowering of the standard of living would be self-defeating also, as detracting the desired immigrants; and

(*d*) Markets, both home and oversea.

One of the main problems before the Australian community is to absorb into current production the population formerly and still dependent upon "development." It was the large proportion so dependent that made the depression so severe, and which accounts for the large numbers still sustained by public works.—J.B.B., in "Economic News" (Brisbane).

Middle-aged—What?

Sir Philip Gibbs writes some consoling thoughts for people who have left youth well astern in a recent magazine article. This is what he says, *inter alia*:—

Middle age is more active than adolescence, when there is time for dreams. It is keener to do things, to find things out, to help things forward, because time is getting short, maybe, and there are so many things to do, to see, if possible to know, before the "chucker-out" knocks on the counter and says, "Time, gentlemen, please!"

It is the middle-aged men and women who are setting the pace these days. It is they, and not the younger crowd, who are busy shaping out the future—not without anxiety—trying to prevent another massacre of innocents, doing something to make life more pleasant for those who are coming along, adding a little to the store of knowledge, writing books that are most worth reading (at least more worth reading than those produced by undeveloped minds), controlling, organising, handing on a torch which youth seems reluctant to hold lest it should burn its fingers, or lest it should go out, as perhaps it may, when the wind blows.

It is middle age which has most mental energy, most interest in the affairs of life, most staying power, and most enthusiasm for a game or a job. Youth says, "Why worry?" but middle age says, "Let's get a move on." Youth says, "There's lots of time ahead," but middle age says, "Do it now, or time may catch us bending."

Youth is leisurely. Middle age is in a hurry—to play one more set of tennis, to enjoy one more game of chess, to make the most of another spring, to walk towards another sunset, to set out on another adventure, to find a good job, or to patch up a bad one, because time does not stand still on the other side of fifty. It rushes ahead.

The mind does not become middle-aged nowadays. It remains strangely and incurably young, in spite of the mask that conceals it—those grey hairs, those crows' feet. It is the same mind that looked out upon the world at twenty-five with just a little more experience (but not much), a little more tolerance for other people's habits, a little more pity, and a secret sense of humour in seeing how other people are as foolish as themselves.

Intellectually, spiritually, there is no such thing as middle age nowadays. We refuse to admit it. I am beginning to doubt whether there is any such thing as old age. At fifty one is just beginning another adventure, not saying, "Good-bye to all that." Middle-aged? Nonsense!

Remarkable Team Driving.

In a letter to "The Australasian," Mr. J. D. Cramond, of Wangaratta, quotes from Ion L. Idriess's book, "The Cattle King," where, on pages 324-5, reference is made to the late Sir Sidney Kidman having said "he remembered the Kennedy brothers driving a team of four blood horses from Wonnaminta Station to Wilcannia, 110 miles, in ten hours."

"This," says Mr. Cramond, "works out at an average of 11 miles an hour, so that if the actual travelling time from the start of the journey to the finish was ten hours, as one would infer from the statement, it was a most remarkable performance. Possibly some of your old-time readers may know of a better record. However, in my experience, it is outstanding."

Shearing and Shearers.

In an article in "The Australasian" recently, E. S. Sorensen, the noted Australian writer, gave some very interesting particulars of remarkable shearing achievements with the blades, and later with machines, and from which the following extract is taken:—

In the days of the blades and big flocks, when sheds such as Milo, Queensland, shore up to 500,000 in a year, contests between noted shearers were not uncommon, though they were not very widely heard of unless there was something of special interest attached to them. Matches were usually made at a wayside hotel, perhaps for a £5 or £10 wager, and the contest took place on the last day or two of the shearing. Often it was the outcome of arguments between others as to the merits of two local champions. Bets were made, and a stake was provided for the two to settle the matter with a hundred-sheep race or in a whole day's shearing. It seldom happened, however, that two of the much-talked-of "big guns" of the day met in a shed, and there were only the tallies and times by which to decide who was the champion.

Tallies were not always reliable. The "cut," weight, and density of the fleece, varied a lot in different flocks. Some were clean, others dirty or sanded. Again, some sheep were more wrinkly than others. Bigger tallies were made in ewes than in wethers, though many old ewes were tough enough to be cobblers in a mixed pen. The quantity of yolk also had some bearing on cutting quality. Shearers with a reputation could pick their sheds. They knew the quality of the sheep on the various runs they passed through, and mostly got stands in the big sheds, disregarding the small places.

As far back as 1876 a match took place at Parratoo, South Australia, for £50 a side, between Angus McInnes and Jack Gunn. These men were two well-known "fliers" of their day, and the contest for the championship was probably the first for a substantial stake. It was to have been decided on the tallies for a day's shearing. McInnes shore 180 sandback wethers, when the pens ran out.

Among shearers it was an honour to ring the board—that is, to shear the highest tally for the shed, whereas the drummer, who figured at the bottom of the tally list, was the object of much good-natured chaff. The important inducement to speed with all shearers was the cheque. Each wanted to get as much out of the shed as he could. But the honour of being the ringer was a considerable spur to the topnotchers. There were always several men on a board cutting against one another, whether there was a wager or a prize at stake or not. Record tallies were mostly made as a result of such contests.

At Barenya, Queensland, on 19th September, 1895, eight men averaged 236 each; on 20th September, twenty-six men averaged 175 each; and next day Jimmy Power, the champion machine shearer of his time, made his record of 315 mixed sheep in less than eight hours.

Previous to this, in 1892, Jack Howe made the great record of 321 sheep with the blades at Alice Downs. For this achievement he received a ten-guinea gold medal from Coleman and Sons, of Cootamundra, N.S.W. A little later the same year, at Barcaldine Downs, he first worked with the machines, and in this initial effort turned out 276 in eight hours. He received a medal for this tally also.

Howe figured in one remarkable contest. A New Zealand champion named Harlin set out to lower his colours at Evera Station—and he had backers. The sheep carried heavy sandy fleeces, a condition that always meant a big drop in tallies. On the day shearing started Howe's tally was 111, Harlin's 92. Every succeeding day Howe turned out exactly the same number, while the New Zealander steadily got nearer to it. His backers were sure that with a little extra spurt he would ring the board. They expected to see Howe break up when hard-pressed. Wagering increased, and special inducements were offered to Harlin on Saturday. He shore 84 for the half-day, but was knocked out, like his backers, when Howe unfleeced the usual 111, and walked nonchalantly off the board with time to spare.

Harry Livingstone, the recognised Queensland champion of later times, shore in successive days 233, 235, 237, 237, and 221—a very profitable five days at 24s. a hundred. Higher tallies than these were put up in a race between several cracks at Cambridge Downs in 1910, but Livingstone was a very clean shearer, who treated his sheep without ever requiring the services of the tarboy. At the shed mentioned 117,000 sheep were put through in four weeks by a board of thirty-eight shearers. In one day, working on ewes and lambs, the whole team cut an average of 198½ sheep a man. The top scorer was Harrison, with 265; then came W. Garvey, with 259; S. Hookway, 250; J. Boyland, 246; Jack Seary, 244; and many others over the 200 mark.

At Wantalaynie, near Winton, five shearers in one day averaged 269 sheep a man in a go for shed honours. A clean left-hander, known as "Nugget" Daniels, shore 125 lambs in two hours ten minutes with cutters at Lenham Station, Queensland, and on the following day shore 280 full-woolled wethers. The best sprints were made in earlier years. "Long" Maloney, in 1874, shore eleven big wethers in eleven minutes at Fowler's Gap, near Broken Hill; and at Belalie, on the Warrego River, Sid Ross shore nine lambs in nine minutes.

In 1911 a purse of £500 was offered at Toowoomba, with a £100 side wager, to settle the question of the Australian shearing championship. But none of the noted shed champions of the time, such as Harry Livingstone and Dan Cooper, took part in it. The contest was between Fred Zimmerle, a Toowoomba native, and Charlie Maurer, of Glen Innes, both of whom had high local reputations. Points were awarded for quality and style, and the men consequently paid more attention to quality and style than they would have done in an ordinary shed. The conditions called for only two and a-half hours' shearing, about the equivalent of a "run" in a shed. The sprint was won by Zimmerle, who shore thirty-two sheep to Maurer's twenty-eight.

Against this, Dan Cooper's time in a shed, shearing all day, was under two minutes for a sheep. His record for a single sheep was 1 minute 38½ seconds. He shore 315 with the machines at Bundoran, Lower Flinders, in a working day in 1910. In the 1909 season he aggregated 37,502, but his sheds ranged over New South Wales, Queensland, and New Zealand. Cooper began as a rouseabout, and practised shearing by doing a cobbler at smoke-o times. When he was promoted to a stand he shore a hundred sheep on his second day.

In a shearing contest in Sydney in 1911 for the "championship of the world," Dan Cooper won from Syd Day, the South Australian champion, but the number of sheep shorn was below shed records, quality and style being again in the reckoning of points.

Day tallies made by some shearers in the same shed were not always reliable. A veteran of western sheds, who belonged to the good-humoured "unparticular sort," enlightened me on that matter.

"The bloke who rings the board isn't always the fastest shearer in the shed," he said. "I'll tell you a trick—and it's pretty common, too. Snip Sinker had the name of being a fast shearer, when he liked to extend himself; but he was mostly too lazy, or had a cronk wrist, or a kink in his back, when there were big guns on the board. He'd put up some big tallies here and there, but only his mate knew how. I was his mate when he made his record. 'I'm after it to-day,' he said in the morning, 'and you've got to help me. But keep a sharp eye on the overseer and the Wop Wops' (the pickers-up). Well, he'd helped me to surprise the mob at another shed, so I cuts in as if I'm racing him. He was a fair-to-middling shearer, but no scorcher. Every now and then I slipped a sheep down his chute, which made him faster than ordinary. I shore 150 that day, and Snip got through 170. But only 100 was counted out of my pen, and 220 out of Sinker's. It surprised the mob, I can tell you. Now when I see a bloke cutting for the shed record I keep an eye on his mate."

This trick was sometimes worked when there was wagering on the board, especially when a man had backed his mate against another shearer and there was nobody appointed to watch the contestants. Besides slipping a sheep now and again into his mate's chute, he left him all the easiest sheep in the catchpen, taking the hardest himself. The rouseabout whose job was to refill the pens as they were emptied was also induced to assist by putting all good sheep in the rogue's pen and all the bad sheep in his opponent's.

The big-gun shearers never stooped to any practices of that sort. When Jack Howe was catching sheep he did not waste time looking for soft ones, but grabbed the first he could get his hands on, which might be the hardest old ewe in the pen. In Queensland the sleeveless shirt worn by shearers is called a Jacky Howe. At one time there was a racehorse called 321, in compliment to Howe's record tally. The horse was raced on West Queensland courses, but was more of a drummer than a ringer.

There were other records in sheds as well as tallies. An unusual one was made by George Smith, of Dubbo district, New South Wales. He first shore at Bundemar in 1884, and from that time he never missed a season at that shed for fifty years, completing the half century in 1934. On that occasion E. L. Brody, of Bundemar, presented him with a cake decorated with a sheep and a pair of shears, also a cheque for £50—one pound for each year he had shorn there.

When "Gun" Shearers were Beaten.

Commenting on the foregoing article on Shearing in a subsequent number of "The Australasian" (Melbourne), an old blade shearer, Mr. A. J. Sullivan, writes very interestingly as follows:—

As an old blade shearer, now in the last half of my 81st year, I hope you will allow me a little space to air my views on shearing, shearers, and squatters.

As a preliminary, I think it will be as well to state my qualifications to pose as a judge of shearing. I first went into a shearing shed in 1872. In 1874 I commenced to shear. From 1874 till 1886 I sheared in Victoria, New South Wales, Tasmania, and New Zealand. During 1891-2-3 I sheared in Victoria and New South Wales.

I am not going to doubt the correctness of any of the tallies quoted by your correspondent, E. S. Sorenson, in your issue of 18/4/36 (Notes and Queries, "Shearing Contests"), but I am going to affirm that no man ever did, or ever will, shear that number of sheep properly*.

Let me give some illustrations to prove my contention. In 1878-9, 1880-1-2, I sheared at Brookong station, New South Wales. In 1878 and 1879 there were 82 shearers on the board. In 1880 there were 97. At this shed, owned by Mr. William Halliday, with Mr. Riddle, manager, 335,000 sheep were shorn in the general shearing that year.

Up to that date the number of sheep put through one shed had never been equalled and I don't believe that record has been beaten since. At Brookong in 1880 there were ringers from Victoria, New South Wales, Tasmania, and New Zealand, and strange as it may seem, the highest tally in 10 weeks' shearing was 135.

And, stranger still, the big-gun ringers were nowhere in the hunt. The reason of the small tallies was that the owner and manager insisted upon clean shearing.

Again, in 1877, the writer sheared for Mr. John Ware, at his station, Yalla-y-Poora, near Streatham, Victoria. For years there was a limit of 85 sheep a day imposed at this station. And in 1877 one man did 92, which was passed. For years on Longerenong Station and Mount Bute—now a soldiers' settlement—110 sheep was the limit allowed.

Many times during my long shearing career I have known big-gun shearers, where first-class clean shearing was insisted upon, to be easily beaten by ordinary men. In New Zealand during 1879 and '80 I sheared with many whites and maoris, who had done 200 sheep in a day there. If those men were at Brookong 100 sheep would have been their limit.

Here is another example to prove my contention. One day in 1884 I was one of eight men who sheared 1,144 sheep at Hawksview Station, near Albury, New South Wales. After finishinig at Hawksview I was one of four men out of the eight who went to Tasmania. Here are our highest tallies at Hawksview: 175, 163, 156, 154; Tasmania: 101, 101, 101, 86. At Hawksview I did 156; in Tasmania I was one of the three dead-heaters.

The sheep in Tasmania were a little rougher, but they had to be cleanly sheared. Mr. Sorenson, I notice, in his report of the £500 purse, with the £100 side wager, at Toowoomba, Queensland, in 1911, says:—"But none of the noted shed champions took part in it." I notice that in that match one man did 32 sheep, and another man 28 sheep in two and a-half hours. That is an average of 12 sheep an hour.

Now at the risk of being looked upon as an egotist I will quote some of my tallies, the price signed for, and the price received. It must be understood I was never a big-gun shearer. In 1884, at Yanko Station (N.S.W.), 111 sheep, price signed for 17s. 6d. per 100, price received 21s.; 1885, Coolamon (N.S.W.), price 18s., sheep 114, price received 20s.; Pevensey (N.S.W.), sheep 115, price agreed upon 18s., price paid 20s.; 1886, Heartwood (N.S.W.), 120 sheep, price signed for 18s. a 100, price received £1. In the 1884 Tasmanian shearing I did 101, and signed for 14s. a 100, and received 15s.

In my shearing days I met many men who could easily beat me. But none of them ever sheared 200 or 300 sheep in the sheds we met in.

Now in conclusion, during my shearing days it was generally by shearers who knew Australia that a shearer who could shear at Campbell's Duntroon Station (N.S.W.) could shear anywhere in Australia. But I never heard of any big tallies being compiled there.

* Mr. Sorenson in his article quoted figures of 321 and 315 with numbers of instances of days' quantities of over 250.

Tree-planting Time—Preparation of the Land.

Because their wholesale removal has been necessary in the process of land settlement trees have come to be regarded by many farmers almost as an excrescence. There are, however, those who appreciate that trees are of considerable importance in agricultural and pastoral economy as sources of shade and shelter, fuel, fodder, and timber, and that on the score of beauty, too, they have a claim to their place on the farm. Such farmers may be reminded that planting time is now, and that the best results will be obtained if the land has been well prepared.

Where a number of trees are being planted together, such as windbreaks, avenues, or tree lots, the land should be first ploughed. New land should be broken up before winter and allowed to lie until planting time. A plan which has its advantages is to make the first ploughing only deep enough to cover the grass and herbage. Shortly before planting the ground should be cross-ploughed deeply, and then harrowed. Ground previously under crops will probably contain many weed seeds, and to enable the young trees to become established before the weed growth becomes unduly aggressive such land should be ploughed and harrowed and planted immediately afterwards with the trees. Where hillside planting is being carried out the ploughing should follow the contour of the hills as far as possible.

Ordinary hole planting is attended with some risks, especially where the subsoil is impervious. In such cases the hole tends to become merely a pool of stagnant water and a grave for tree life. Where trees must be planted in holes, such as in the case of isolated shade, shelter, and ornamental trees, the holes should be made as large as possible. A hole 3 feet by 3 feet and 2 feet deep is the smallest size allowable, and where possible larger holes should be made.

Where deep digging carries the hole into an impervious subsoil it is better to make the hole wide and shallow, the depth not exceeding that of the soil. On wet, poorly drained soil, ridges or mounds may be formed as sites for planting. Ploughing two adjoining furrows so as to throw the sods together achieves this end in a minor way. Irrespective of what method is adopted the preparation of the land should be completed before stock for planting is obtained.

The best time for planting is when the plant is at its resting period, and when cool, moist conditions prevail. Generally speaking, May to August are the best months. The effects of frosts must be studied, and spring planting is often necessary in some localities, except for deciduous species. Where the rainfall is heavy and conditions generally are cool the planting period may be considerably extended. A cool, cloudy day and a fairly moist soil provide ideal conditions.—"A. and P. Notes," New South Wales Department of Agriculture.

Can Cows Hold Up Their Milk?

Can cows voluntarily hold up their milk? It was stated in the January issue of the "Farmer" that a cow could instantaneously exert this power. In the February issue "Observer" denied that a cow has the power to hold up her milk at will, and affirmed that when this habit occurred it was almost invariably the effect of the treatment to which the cow was or had been subjected. An experienced dairy farmer (Mr. A. Montgomerie, Kauwhata) desires to join in the debate. He says he has had quite a number of cows that required to be taught to let down their milk. There are, he says, many sulky cows—one expression of the sulks being milk-holding. The trouble, however, was largely the result of having been badly broken in as heifers. Twenty-three years ago he had a heifer that he valued very highly, and to his intense disappointment she developed this bad habit. After reflection he introduced the calf to her, and after the first few muzzlings the milk promptly arrived almost to bursting point. While allowing the calf some latitude about the udder and at the teats he milked the heifer out. This business was repeated for some days until the animal became accustomed to being milked right out, and after that she was quite all right. Since that time he has had several similar instances, but by breaking them in the same way they have all been made tractable, the "cure" taking, on an average, three or four days. Another point to which Mr. Montgomerie has taken exception is that the use of the dog is a cause of the milk-holding trouble.

(It should be stated here that "Observer" expressly said the "hard dog." Doubtless Mr. Montgomerie's claim is that a good dog would not cause trouble. Mr. Montgomerie proceeded to express the desirability of breaking heifers into the shed (with the use of the dog if one prefers it), the bail and the leg rope before they have calved. Afterwards they would only need to be broken in to the process of milking, and little or no difficulty about milk-holding would be experienced. If an occasional sulky one did hold the milk back, the useful aid of the calf provides a ready remedy.—"Himi," in "The New Zealand Farmer."

Jersey Breeding.

One of the aims of the Jersey breeder should be to breed only from well authenticated dairy ancestors, disregarding entirely the question of the value of the carcass of the animal when finished with. There is a difference of opinion regarding the live weight of Jerseys. Some breeders think that there should be no limit to the size of the Jersey cow, contending that the larger animals are stronger in constitution and yield more milk of equally rich quality. Others believe that with largeness of frame an increase of milk, though of poorer quality, is obtained, and that the smaller animals are the best for butter. The average of seven years' weighings at the London Dairy Show was 850 lb. live weight, which is considered by the majority of English breeders to be about the correct weight.

The history of the Jersey cow points a moral that cannot be overlooked; beauty and utility should be combined. Although always noted for dairy properties, it was not until show ring points (which are indicative of good dairy cattle) were drawn up, and some uniformity of aim was arrived at among breeders, that the increased demand arose for Jerseys from other countries, with a consequent increase in their value. To sacrifice appearance to dairy qualities, or the reverse, must in either case be wrong.

The only question in the selection of a bull by the most astute breeders on the island is whether the breed is a good one? Meaning, had its progenitors been renowned for their milk and butter-fat production. Breeders agree that the sires used in the herd should have good dairy ancestors for several generations, and with this individual appearance should be considered. On the island of Jersey a masculine-looking bull is preferred, while some English breeders favour a bull of feminine appearance. In Jersey, where in consequence of the warmer climate and the difference in the system of rearing the cattle are naturally finer and, consequently, smaller than in England, it is thought best to use bulls of strong constitutional appearance; while in England, where the cattle are apt to grow coarse, the use of smaller and more feminine-looking bulls is, by some breeders, considered advisable. At the London Dairy Show an attempt is made to secure both qualifications, viz., appearance and utility, by giving prizes by inspection to bulls descended from dams that have won butter test prizes. The secret of success in the management of cattle generally, whether Jerseys or not, is to study the individuality of each animal. To put it briefly, the temperament and constitution of an animal must govern its treatment, and this supplies the key to successful management.—F.W.L., in "The Australasian."

Trees on the Farm.

It is good to observe a growing "tree consciousness," especially in areas which, in the march of closer settlement, have been almost entirely denuded of native timber.

The usefulness of trees can be demonstrated in these ways:—

As windbreaks and shelter belts.

As isolated or scattered shade and shelter trees.

As a reserve supply of fodder for periods of drought.

As tree plantations to supply the timber and fuel requirements of the farm, in addition to providing a source of revenue by the sale of products.

As screens around dams and tanks to prevent silting up by dust and undue evaporation of the water contents.

As a means of preventing erosion on slopes and along the banks of creeks and rivers.

As a means of enriching worn-out or poor land.

As ornamental trees in improving the appearance of the homestead.

As bee trees.

Generally speaking, May to August are the best months for tree planting.

Where proper shelter is not provided for stock not only is their resistance to disease reduced but much food material is wasted in meeting the increased demands of an exposed body. This fact has an important application for dairy farmers. A cow's food is only devoted to production after the animal has satisfied its needs for nourishment and heat.

Conservation of the lastmentioned, especially in colder districts and situations, is considerably assisted by judicious tree planting. Shelter belts in the form of trees and hedges are a valuable aid to the well-being and productivity of the dairy cow, and now is the time of the year to plant.

Utilisation of Dairy Lands.

Not so many years ago, observed Mr. A. F. Emmott in a paper read recently before the Bodalla Branch of the Agricultural Bureau of New South Wales, it was the custom on all dairy farms to have a few paddocks only for the milking herd—perhaps one or two day paddocks and a night paddock. How such an inefficient system managed to survive so long was difficult to understand. Perhaps it was because the old-time farmer was very conservative, and followed closely the methods of his forefathers, viewing with great distrust any "new-fangled" ideas. In his opinion, said the speaker, the most important step towards pasture improvement was the subdivision of the farm, particularly the best and richest portions, into small paddocks.

The greater the number of small paddocks available, the greater will be the use made of the pasturage at its optimum stage of feeding growth. It has been demonstrated by analysis in England that grass cut at three-weekly intervals retains the non-lignified, highly digestible character, which it possesses at the end of a week's or a fortnight's growth, and that this characteristic of high digestibility obtained by cutting at three-weekly intervals is maintained throughout the entire season.

By having a large number of small paddocks which can be rotationally and heavily grazed for about two days by the milking cows, and from two to three days by the followers, and then permitted a three to four weeks' spell before being grazed again, it is possible always to have available pasturage that retains its high digestibility and nutritive value, which makes its eminently suited to supply the food requirements of most farm animals. Moreover, in large paddocks considerable food wastage occurs on account of excessive tramping and fouling of the pastures by the stock.

The size of the paddocks will mainly depend on the number of milking cows to be grazed and on the fertility of the land. The figure generally adopted in our coastal districts for good paspalum-white clover areas is twelve cows per acre. A farmer milking on an average of sixty cows on this class of country would, therefore, require to subdivide into 5-acre paddocks in order to obtain proper control of growth and efficient utilisation of the pasturage.

To reduce the cost of subdividing paddocks, fences consisting of three barbed wires, or the top wire plain and the two lower ones barbed, with posts 15 to 16 feet apart, can be used instead of erecting costly permanent lines of fencing, as it may be necessary at a later date to alter the general lay-out of the farm. Each paddock should open into a laneway, race, or long, comparatively narrow paddock that leads to the water supply. It is important that this area should be fairly wide, at least 50 feet, in order that the cows will not be herded together at any time in a narrow strip; this will reduce danger of injury through horning, &c., and also prevent the area becoming a bog in wet weather.

When commencing this system of grassland management, a start should be made with the most productive grass areas, gradually bringing other paddocks into the scheme. It is inadvisable to grass-farm intensively all the pasture paddocks on the holding until adequate fodder reserves of crop and grass silage or hay are built up to tide over dry periods and winter months.

The provision of suitable shade trees in the paddocks is most important; sufficient attention is not given to this essential work even in the large paddocks which are to be found on most of our dairy farms at the present time.

Travelling Dogs.

An interesting story is revived by a correspondent to "Notes and Queries," in a recent "Australasian," and an interesting avenue of research into the journeys of dogs unaccompanied by their masters is opened up. He recalls that an Englishman, "Edward Cook, of Togston, in Northumberland, who died at Togston in 1786, visited America, taking with him a pointer dog which he lost while shooting in the woods near Baltimore.

"Some considerable time afterwards his brother, who was living at Togston, was alarmed in the night by the barking of a dog which, when admitted, was recognised as the dog which had been taken to America. On Edward Cook's return he and the dog recognised each other. All efforts to trace the vessel by which the animal had left America were unavailing, nor was the place where it had landed in England ever discovered."

Records of such long-distance travelling by dogs, here, in Australia, or overseas, would make interesting reading.

Clean Milking.

At a Southern cheese factory contaminated milk was traced recently to the handling of dirty leg ropes and bails. Regular washing of the hands in running or frequently changed water is a precaution well worth while when milking. It is a practice beneficial on three counts—it tends to prevent contamination of the milk, it lessens the risk of transmitting disease from cow to cow, and it invigorates the milker's tired hands and wrists. Before the cow is milked the udder should be wiped with a clean, damp cloth; this is preferable to brushing, which only causes the dirt to float in the atmosphere and subsequently to drop into the milk bucket. A separate cloth should be used by each milker and should be kept thoroughly clean and sweet—a smelling cloth is a source of contamination. Where gravitation water is not available a good plan is to have, say, two oil drums, into each of which is fixed a small tap. These drums should be fixed to the posts or walls.

Dry versus wet milking is often a debated point, but the practice of drawing a little milk into the bucket and dipping the fingers therein is undoubtedly most insanitary. A good plan is to touch each teat with a little vaseline, which prevents friction, and also prevents cracks on the teats.

Vitamins.

Thus the Medical Correspondent of the "Sydney Morning Herald":—

Vitamins are complex organic substances that occur in almost all natural foods. The percentage of these present is very small indeed, but a certain proportion in the diet is absolutely essential to health and even life.

Although the discovery of vitamins is recent, it had long been known that ill-health and death resulted from the absence of certain foods from the diet. For example, sailors in the days of long voyages were found to suffer from scurvy, but it was known that the disease could be averted by a supply of fruit and fresh vegetables, and even by a daily ration of lime juice. Formerly rickets was a common disease of infancy, especially under slum conditions. It was known long before vitamins were discovered that rickets could be prevented by sunlight and animal fats, especially cod-liver oil.

There are a number of distinct vitamins, and the absence of any one of these from the diet causes characteristic symptoms. One of the triumphs of modern medicine was the abolition of beri-beri from the Japanese Navy. This is a disease of the nervous system causing paralysis and dropsy of the legs, and is a vitamin deficiency disease. The rice supplied to the navy was polished, and the substitution of unpolished rice abolished the disease at once. The diet of armies, explorers, &c., is now carefully calculated to prevent the possibility of any vitamin deficiency, and the late war was fought without any outbreak of scurvy or other deficiency disease.

If the supply of vitamins falls below a certain amount health is definitely affected, but it is not true that amounts in excess of the minimum are in any way beneficial. It can be taken for granted that there is no inhabitant of Australia, other than babies artificially fed and a few inhabitants of the outback, who do not take every day every vitamin in a dose far in excess of requirements. The public has become vitamin conscious, and many people are taking artificial vitamins which are quite useless and unnecessary, or are mistakenly regulating their diet from a vitamin instead of a nourishment and palatability point of view.

The exceptions to this are artificially-fed babies. Cow's milk is deficient in the vitamin requirements of the young human. The necessary vitamins can be easily supplied by daily doses of halibut or cod-liver oil and the juice of orange, grape, or tomato, whichever may be in season.

Some remote country dwellers live very close to the safety margin, or even below it. These are those whose diet consists for the most part of mutton, damper, and tea. Barcoo rot is a vitamin deficiency condition. These bush dwellers get plenty of the valuable vitamins contained in animal fats, but need fresh fruit, salads, and vegetables for safety.

Rain to the Minute.

Speaking at a dinner in his honour at Nanango, Sir Leslie Wilson strongly advocated irrigation in the development of Queensland. "Then," said he, "you will not have to rely on Mr. Inigo Jones. I'm a great believer in Mr. Jones. He is more often right than wrong. He was right to-day almost to the minute."—"Nanango News."

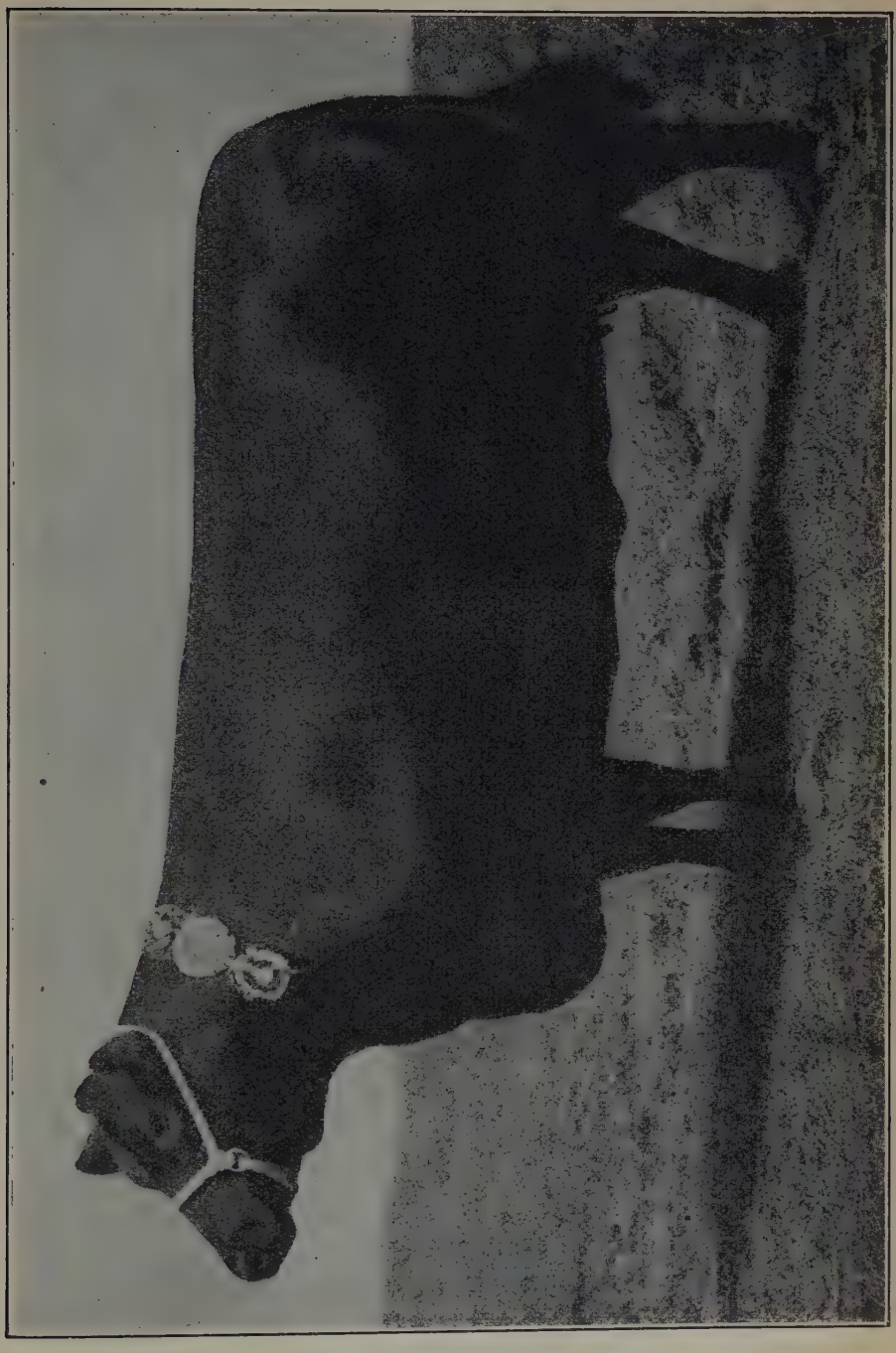


Plate 129.—The type of Aberdeen Angus Cow favoured by Scottish Breeders.



Plate 130.—A type favoured by Jersey Breeders in Britain.

Orchard Notes

SEPTEMBER.

THE COASTAL DISTRICTS.

In the North Coast and Gayndah districts the bulk of the citrus crops have been harvested with, perhaps, the exception of Valencia Lates. Orchard activities should be directed towards pruning, cultivation, fertilizing, and spraying. As a result of seasonal conditions and in some instances heavy crops, there are numerous instances of trees showing signs of impaired vigour, and these will require a severe pruning both in thinning and shortening back, removing superfluous growths, and diseased and weakly woods. Healthy and vigorous orange trees will require little attention beyond the removal of crowded lateral growths.

Mandarins will need special treatment, particularly Glen Retreats and Scarlets. These varieties usually produce a profusion of branches, and as the trees mature the growths harden and the fruit-bearing shoots make short, weakly growths which generally results in an over-production of small fruits and a weakening of the trees. This is particularly noticeable in the case of the former variety. Here the annual pruning should consist of a heavy thinning and shortening back. Mature mandarin trees require attention towards assisting them to produce new and vigorous fruit-bearing growths.

Unprofitable trees should receive attention and be prepared for top-working. They may be headed back to three or four main arms radiating from the stem and white-washed to prevent bark scald. Such trees may be grafted or later budded when suitable growths have matured.

Prior to working up the soil fertilizing should receive attention. The spring application should carry a high percentage of nitrogen.

In the warmer districts which are free from frosts plantings of young trees may be made. Serious consideration should be given to the selection of commercial varieties only, and having due regard for local conditions, selections may be made from the following varieties:—Washington Navel, Joppa, Siletta, Valencia Late, Beauty of Glen Retreat, Emperor, Scarlet, Solid Scarlet, Marsh Seedless or Thompson Grapefruit, and Villa Franca, Lisbon, and Genoa lemons.

Where Melanose and Black Spot are present in orchards preparations for control measures should be made, and Bordeaux sprays applied at the correct times.

The majority of citrus trees would be considerably benefited by the application of a strong lime-sulphur wash, 1-18.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

Black aphis should be fought wherever it makes its appearance by spraying with a tobacco wash, such as black-leaf forty, as if these very destructive insects are kept well in hand the young growth of flowers, leaves, wood, and fruit will have a chance to develop.

The working over of undesirable varieties of fruit trees can be continued. The pruning of grape vines should be done during the month, delaying the work as long as it is safe to do so, as the later the vines are pruned the less chance there is of their young growth being killed by late frosts. Keep the orchards well worked and free from weeds of all kinds, as the latter not only deplete the soil of moisture but also act as a harbour for many serious pests, such as the Rutherglen bug.

New vineyards can be set out, and, in order to destroy any fungus spores that may be attached to the cuttings, it is a good plan to dip them in Bordeaux mixture before planting. The land for vines should be well and deeply worked, and the cutting should be planted with one eye only out of the ground and one eye at or near the surface of the ground.

In the warmer parts, which are suitable for the growth of citrus fruits, the land must be kept well cultivated, and if the trees need irrigating they should be given a good soaking, to be followed by cultivation as soon as the land will carry a horse without packing.

In these parts fruit fly should be systematically fought, as it will probably make its appearance in late citrus fruits and loquats; and if this crop of flies is destroyed, there will be every chance of the early crops of plums, peaches, and apricots escaping without much loss.

Farm Notes

SEPTEMBER.

WITH the advent of spring, cultivating implements play an important part in farming operations.

The increased warmth of soil and atmosphere is conducive to the growth of weeds of all kinds, particularly on those soils that have only received an indifferent preparation.

Potatoes planted during last month will have made their appearance above the soil, and where doubt exists as to their freedom from blight they should be sprayed with either Burgundy or Bordeaux mixture as soon as the young leaves are clear of the soil surface.

Land which has received careful initial cultivation and has a sufficiency of sub-surface moisture to permit of a satisfactory germination of seeds may be sown with maize, millets, panicum, sorghum, melons, pumpkins, cowpeas, broom millets, and crops of a like nature, provided, of course that the areas sown are not usually subjected to late frosts.

Rhodes grass may be sown now over well-prepared surfaces of recently cleared forest lands or where early scrub burns have been obtained, and the seed is sown subsequent to showers. More rapid growths, however, are usually obtainable on areas dealt with, say, a month later.

In connection with the sowing of Rhodes grass, farmers are reminded that they have the Pure Seeds Act for their protection, and in Rhodes grass, perhaps more than any other grass, it is necessary that seed of good germination only should be sown. A sample forwarded to the Department of Agriculture will elicit the information free of cost as to whether it is worth sowing or not.

Where the conditions of rainfall are suited to its growth, paspalum may be sown this month.

The spring maize crop, always a risky one, requires to be sown on land which has received good initial cultivation and has reserves of soil moisture. Check-row seeding in this crop is to be recommended, permitting as it does right-angled and diagonal cultivation by horse implements, minimising the amount of weed growth, and at the same time obtaining a soil mulch that will, with the aid of light showers, assist to tide the plant over its critical period of "tasselling."

Although cotton may be sown this month, it usually stands a better chance if deferred until October, when the warmer temperatures allow of the obtaining of better germination and promote a healthier growth of the resultant seedlings. The harvesting of cotton during the normal rainy season is, if possible, to be avoided.

The sowing of intermediate crops prior to the preparation of land for lucerne sowing should be carried out in order that early and thorough cultivation can take place prior to the autumn sowing.

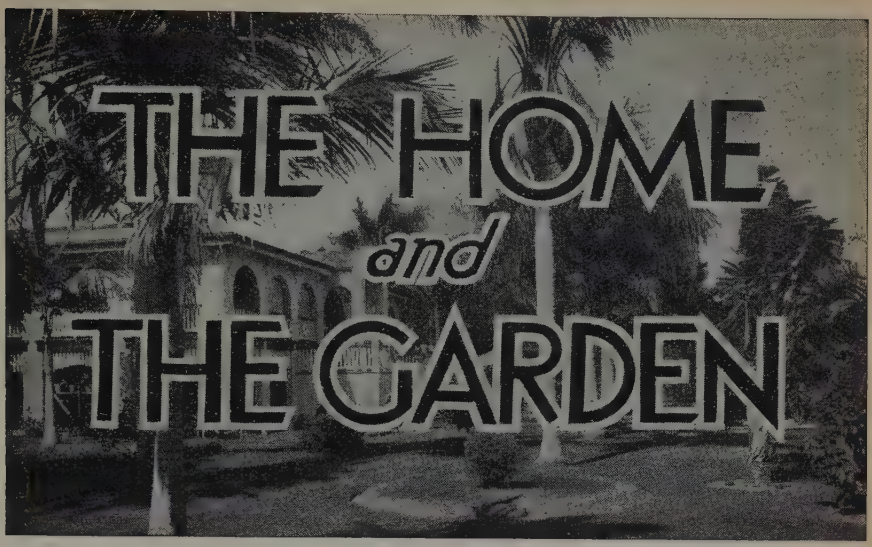
The following subsidiary crops may be sown during the month:—Peanuts, sweet potatoes, arrowroot, cow cane, and in those districts suited to their production yams and ginger. Plant out coffee.

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OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

JAWS AND TEETH WERE MADE FOR USE.

WELL formed jaws and sound, beautiful teeth cannot be formed without regular strenuous exercise, and this should be commenced by the sucking of the newborn infant, kept going by biting in the teething age, and encouraged by hard, crisp foods throughout childhood.

For Beauty and Health.

This exercise is not only necessary for the growth of a well-formed, beautiful face; it also invigorates the whole body.

The mouth is indeed a great primal "driving station," whence the nerve fibres carry impulses to the nerve centres, which quicken the life and activity of every tissue of the body. When the jaws are doing natural, honest, hard work the whole of the rest of the organism is impelled to activity—the heart pumps quicker and more forcibly, and the pressure of blood in the arteries rises and its stream flows more rapidly, even in the very finger-tips; at the same time the digestive juices are poured out freely, not only into the mouth but also into the stomach and bowels, as the result of messages transmitted from the mouth when busily engaged in mastication.

"Feeding exercise" is the most primitive, fundamental, and essential of all forms of exercise. A horse fed mainly on hard, dry food (and reasonably treated in other respects) becomes the ideal of strength and "fitness." Feed the same horse with soft mashes made from similar food materials, and he will become soft and "out of condition," simply because his whole organism will then lack the primary stimulation of daily, normal, active exercise which formerly he had to devote to

crunching the oats, &c—activities which are not called forth when dealing with food provided ready ground and softened food on which the work has been already done by millstones and mashing outside the animal body.

The same applies to ourselves—particularly to the young, who are always nearest to Nature. We need the exercise of active mastication, and the only effective means of ensuring this is to start training at the dawn of life. Never let a healthy infant take a meal in which he is not compelled to do active work in the form of sucking or chewing. We must begin with the baby and foster his natural tendency to masticate instead of doing everything in our power to make the function die out by disuse.

The Curse of Pap Feeding.

The mother should banish from her mind the idea of "pap feeding" being the natural course to pursue with a child who has teeth. Milk is best used as a drink, not as a fluid in which to soak food which would otherwise need chewing and insalivating. Parents who once grasp the fact that the more exercise a child can be given for mouth, jaws, and teeth the more he will tend to thrive will not be at a loss to find means by which the carrying out of what is needed can be ensured. Thus the small allowance of meat that a child may have is best given in the form of a bone, from which he can gnaw and tear off with his teeth what is eatable. The more extensive the bone surface to which the meat is attached the better, but even a small mutton chop bone chewed in this way will afford a considerable amount of very healthy, stimulating, and enjoyable recreation. Fortunately, the hands and lips are not unwashable.

Hard rusks, or what is better, fingers or slices of cerevite or wholemeal bread baked hard and crisp are excellent for the jaws. Hard oatcake is an acceptable change. Raw apples are superior in all ways to soft stewed fruit. Even raw carrots and turnips are good for older children, not to mention almonds and other nuts. Best of all would be a small piece of fresh sugar-cane; worst of all are sweetmeats made out of sugar.

IN THE FARM KITCHEN.

FOOD VALUE OF BEEF.*

Beef is an important source of animal protein. Furthermore, it yields energy in degrees varying with the amount of fat present, supplies mineral salts, especially iron and phosphorus with some copper, and in the case of glandular organs appreciable amounts of vitamins. Beef also contains small amounts of extractives which have little food value but are extremely important because they give flavour and act as stimulants to the flow of digestive juices.

All cuts of beef have much the same food value and contribute essentially the same food factors to the diet. However, fat meat has a higher calorie value than lean meat.

As knowledge of the protein values is increased there is greater stress given to the animal proteins such as meat, eggs, milk, and cheese because of their higher biologic value. In experimental work by Minot and Murphy the value of the iron and possibly the copper, particularly in liver, has been demonstrated. Although beef is known to be a good source of iron and phosphorus, it is low in calcium.

Ordinary beef muscle is not a rich nor an economical source of vitamin A; however, the adipose tissue contains significant amounts. Liver is a richer but quite variable source. Liver also shows a higher concentration of vitamin G than do other tissues, but its concentration of this vitamin compared with that in

* From a paper by Ruth Tucker, Department of Food Economics and Nutrition, Kansas State College, U.S.A., in "Beef Cattle in Kansas" (Kansas State Board of Agriculture).

muscle is not as great as the vitamin A content. Day reports that there is vitamin G in the fresh tissues of beef and veal, but that beef heart is three times and liver ten times as potent. There is too little vitamin C in muscle beef to be measured by present methods even though observations on human scurvy have shown it possible to eat sufficient fresh, raw or "rare" meat, to prevent this disease. It is probably not safe to depend upon cooked meat for vitamin C since this vitamin is readily destroyed by heat. Meat may also contain some vitamin B, but it is usually considered better in vitamin G than B.

Care of Beef before Cooking.

Beef should be removed from wrapping paper as soon as possible, placed in a covered container and kept in a cool, clean place until ready for use. When preparing it for cooking, it should be wiped clean with a damp cloth, wrung from cold water. It should not be washed in water, as this removes some of the soluble extractives.

How to Use Different Cuts of Beef.

As constant repetition of an article of food prepared in the same way tends to dull the appetite it is desirable to introduce variety into the diet. When markets offer a limited choice, variety in preparation of a few food materials is one of the best ways to solve the problem.

Tender cuts of meat are in greater demand, chiefly because they can be cooked quickly. Consequently they sell at higher prices. Skilful cooks can economise by buying less tender cuts and cooking them in a way which makes them palatable. Long, slow cooking, pounding, chopping, grinding, and addition of acids such as tomatoes, sour cream, or lemon juice are methods which improve less tender cuts.

The principal cuts of beef and some of their uses are as follows:—

Cuts	Uses
Forequarter—	
Rib	Oven roast, rolled or standing
Chuck	Steak, Swiss or fry (sauté)
	Pot roast
	Stew
	Oven roast
Plate, brisket, and short ribs	Corn
	Braise
	Stew
Foreshank	Stew
	Soup
	Ground meat
Neck	Soup
	Stew
Hindquarter—	
Round	Steak, Swiss or fry (sauté)
	Pot roast
	Oven roast
	Ground meat
Rump	Steak, fry (sauté)
	Pot roast
	Oven roast
Hindshank	Soup
	Ground meat
Loin	Steak, broil
Sirloin	Oven roast
Porterhouse	
Short	
Flank	Flank steak en casserole
	Braise
	Stew
	Ground meat

Methods of Cooking Beef.

In general, the methods of cooking beef are roasting, broiling, frying, and cooking in water. Roasting, or baking, is cooking by means of dry heat in a hot oven. Broiling is cooking directly over coals, or over or under a direct flame, while pan-broiling is cooking in a heated pan without addition of fat or water. Boiling is cooking in boiling water. When the temperature is below the boiling point it is called simmering. The simmering method is preferable since it gives a more tender product. Braising or stewing is browning the meat then cooking in its own juices, often with the addition of vegetables.

It is generally agreed that a low or moderate temperature is better than a high one. With a low temperature cooking losses are less and meat retains more of its juices although a longer time is required for the cooking process. For thin chops or steaks and thin roasts a high temperature will dry out the meat too much and the interior becomes dry before the surface is browned.

Searing increases cooking losses and should be used only to develop an aroma and flavour on the outside of a roast. Searing may improve appearance of the roast, but it does not affect its inside flavour no matter whether the cut is browned at the beginning or the end of the cooking period. With high temperatures cooking time is materially shortened, but there is a decrease in the important factors of palatability, tenderness, juiciness, and flavour. Meat may not lose a great deal of nutritive value in shrinkage, but where the number of servings is important it should be mentioned there will not be as many if meat is seared. Muscle meat conducts heat slowly, while most metals conduct heat rapidly. Roasting speed is increased 30 to 45 per cent. by inserting nickel-plated copper skewers into the roast, and there also seems to be a decrease in total shrinkage of the meat as well.

Roasts cooked in water are low in palatability, lowest of all in tenderness and flavour, and very low in juiciness.

Weight and shape of a cut of beef affect the length of time for cooking, but are not altogether satisfactory factors by which to determine cooking time. A thin, wide roast will cook more quickly than a thick, compact cut, but a heavy roast the same shape as a lighter piece will require a shorter time per pound for cooking if oven temperatures remain the same, since the weight increases much more rapidly than does the distance heat must penetrate.

Degree of Cooking.

Personal taste plays a large part in the degree of doneness obtained in cooking. When considered medium done by many it may be considered rare by others. Rare meat has a much more distinctive flavour and is tenderer and juicier than meat which has been thoroughly cooked through, yet to many the colour of rare meat is so unattractive that it is unpalatable to them. Rare meat has a brownish coloured layer on the outside, a pinkish layer inside, and a bright reddish portion in the centre. However, this red colour is not the deep red colour of raw meat.

At the medium-done stage beef has a pink colour in the centre, but has turned a brownish-grey at least half way through the meat and the juice that forms when it is cut has a slight pinkish colour. Most people seem to desire meat cooked to this degree. It is very tender and juicy, and the colour is more attractive than in a cut cooked rare.

Well-done meat appears greyish-brown throughout. At this stage it is not so tender and juicy, as the fibres have shrunken and some of the juices have been forced out.

In cooking meat it passes gradually from one stage to another with no definite stage between rare and medium well-done, and between medium well-done and well-done. Heat penetrates slowly into the centre of a piece of meat and unless it is much over-cooked this area never attains the surface temperature. The length of time required to bring a pound of meat to the three different stages seems to be a fairly accurate guide. Periods suggested for standing rib roasts cooked in a slow oven are as follows:—For rare roast, 14 to 15 minutes per pound; for medium-done roast, 17 to 18 minutes per pound; for well-done roast, 23 minutes per pound; but there are variations in requirements. Factors which influence the time are—Cooking temperature, weight or surface area, stage to which meat is cooked, and composition of the meat. The higher the cooking temperature the sooner meat reaches a definite temperature, for heat penetrates to the interior more rapidly.

Usually when a roast is removed from the oven it is placed on a platter or hot pan and allowed to stand while gravy is being made and the rest of the dinner taken up. Unless meat is cut the temperature will continue to rise for about thirty minutes. Amount of this rise depends upon degree of doneness and the temperature to which meat has been cooked. Experimental work shows that the temperature of roasts cooked to the rare stage will rise more than those cooked to a medium or a well-done stage. If meat is cut immediately after removing from the oven then about three minutes longer per pound for each stage should be allowed in the roasting process.

Cooking Losses.

Losses in cooking meat are of two kinds—the evaporation of moisture and volatile materials, and secondly, drippings which when made into gravy are not actual losses. The amount of drippings is quite large when meat is well mottled with fat, but such meat is juicier than very lean meat and a liberal amount of fat

is desirable. Temperature of the oven makes a difference in quality of the drippings. A higher degree makes dark brown drippings which give a good colour and flavour to gravy made from them, while with a lower temperature lighter coloured drippings are obtained.

In meat that is cooked in water there is 10 to 40 per cent. greater loss in boiling water than in that cooked at 185 deg. F. or lower. Often the loss is twice as great in boiling water.

Meat should be cooked in such a way as to increase tenderness of a tough cut and keep tender a tender cut, also in ways which prevent to as great an extent as possible the destruction of food constituents. The method as well as the length of time of cooking may, and often does, spoil a good piece of meat, yet when properly chosen and executed the method may improve a poor piece. Cooking losses of moisture are accompanied by increased dryness and firmness of muscle fibres. The water loss varies with fat content of the fibres and the salt content of meat, as well as with temperature to which meat is heated and length of the heating period.

Time Required for Cooking.

Roast. It is hard to give any definite time for cooking roasts, for this varies with different kinds of meat and other essential factors. In recent experiments a temperature of 257 deg. F. throughout produced the smallest losses and gave the most desirable product if advantages of scaring are ignored.

Steak. It takes from seven to nine minutes to cook a 1-inch steak, and from thirty to forty minutes or longer to cook a 2-inch steak. Steak is usually cooked by broiling, pan broiling, or frying.

Broiling is cooking by direct heat.

Pan broiling is cooking in an uncovered frying pan, pouring off the fat as it accumulates. If the fat is not poured off frequently while cooking, the meat will fry and not broil. The time for pan broiling is the same as for broiling.

Frying is cooking in a small quantity of fat and is specially suitable for cuts deficient in fat. Meat for frying is usually cut thin, browned quickly on both sides, then the heat is reduced and cooking continued at a lower temperature.

Boiled Meat. The term "boiled" is used to refer to meat cooked in water. However, meat should not be boiled, it should be simmered.

Stew. Stew means to cook by simmering heat. The meat is cut into small pieces to increase the surface area, then browned for flavour. After adding water or other liquids it is simmered either on top of the stove or in the oven.

Braise. To braise meat is to brown it in a small amount of added fat, then cook slowly in juices from the meat or with added liquid. Typical dishes which are prepared by braising are casserole meat, Swiss steak, and pot roast.

Casserole meat may be cut into small pieces or left in larger ones. Round or flank steaks are often cooked in a casserole. The meat may be cooked on a bed of vegetables such as carrots, turnips, and celery. Tomatoes may be added for a part of the liquid.

Swiss Steak. After flour has been pounded into the meat it is seared on both sides to brown it. Then water or liquid of some sort is added and the cooking continued in covered utensil by simmering on top of the stove or in the oven.

Tomatoes, sour cream, or other acid substances are often added to Swiss and smothered steaks as well as to some pot roasts. The effect of the acid depends on the amount used and its reaction with the meat proteins. It may cause the meat to swell and retain more water and become tender.

Pot Roast. A pot roast is usually a thicker Swiss steak. Flour is not pounded into the meat. The cut is seared and then cooked as Swiss steak in a heavy, covered pan on top of the stove or in the oven. A thermometer may be inserted to determine when the desired interior temperature is rached.

Soup. The meat is cut into pieces or ground, allowed to stand in salted water and then simmered to extract as much flavour as possible into the liquid.

(To be continued.)

WAYS OF USING UP CORNED BEEF.

Corned Beef Toast.

Take some cold corned beef, ¾ oz. butter, 2 eggs, 1 tablespoonful milk, 1 tablespoonful gravy, pepper, squares of hot toast. Mince beef, put butter into a saucepan, add meat, milk, gravy, season with pepper. Beat 2 eggs and stir in until the mixture thickens; then pour on squares of toast.

Toad in the Hole.

Take slices cold corned beef, ½ lb. flour, 2 eggs, 1 pint milk, salt, pepper. Mix flour in a basin with salt. Beat eggs in milk and stir into flour gradually, beating well all the time. Cut meat into neat pieces and place in a well-greased baking tin, pour over the butter, and bake in a hot oven for one hour.

Corned Beef Surprise

Take ¾ lb. corned beef, 1 oz. butter, 1 oz. flour, 1 cup milk, 3 eggs, salt, pepper, small onion. Put beef and onion through mincing machine, make a thick sauce with the butter, flour, and milk, add beef, salt, and pepper, and mix well. Then add beaten egg-yolks and cook for five minutes. Allow to cool, then fold in stiffly-beaten egg-whites and bake in a deep buttered piedish for three quarters of an hour. Serve at once.

Corned Beef Rissoles.

Take cold corned beef, 1 small onion, breadcrumbs, herbs, pepper, salt, 1 tablespoonful chutney, egg, a little gravy. Put beef and onion through mincing machine, mix with breadcrumbs, salt to taste, pepper, chutney. Moisten with half of egg and gravy, and shape into rolls or balls. Dip in egg (using the half left over), then breadcrumbs. Fry in hot fat.

KING GEORGE V. AS A FARMER.

It was not till 1863 that Sandringham became part of the Royal estates, for in that year the late King Edward VII., as Prince of Wales, bought the original property, which included the parish of Sandringham, the parishes of West Newton, Wolferton, Babingley, and portions of Dersingham and Appleton. This estate passed to King George V. through Queen Alexandra. The problems of changing to early maturity stock and finding by experiment the best commercial beast for British farmers had no greater enthusiast than His Majesty.

At Windsor His Majesty's historic estate comprises about 550 acres. The Windsor stud comprises about 175 head of beef and dairy stock, 300 breeding ewes, and a small select herd of pigs. Actually there are five herds of cattle—two of Shorthorn and one each of Hereford, Devons, and Jerseys. The non-pedigree Shorthorns are of dairy type, and, together with the Jerseys, they provide the milk, butter, and cream for the Royal household. When the King and Queen were in residence at Buckingham Palace the dairy produce and eggs were sent up from Windsor every day by car. The beef stock are a magnificent lot, and are representative of all the best British strains, with their proven first crosses. Many are already famous by their prize-winning at the English beef stock shows, and several were sold at high figures to Argentine, Brazil, and Rhodesia.

Sandringham is a magnificent estate. King George V. was the second Royal farmer at Sandringham, and it was because he was the personal owner of the beautiful Norfolk Estate, bought and developed by his father, because he practised the oldest industry in the land there so well and progressively, sharing with his fellow-farmers the changes of fortune and the struggles and successes that they brought, and because at Sandringham he was the Royal Squire and a model to all who possessed and farmed large estates, that his Norfolk home had a peculiar interest and appeal to agriculturists throughout the Empire. In all that was done within the estate on his own and his tenants' farms he took the closest interest. Like Windsor, it was known best for its pedigree livestock. There the famous Red Poll stud established by King Edward VII. in 1886 was maintained. In smaller stock his late Majesty's flock of Southdown sheep, dating back to 1870, preserved royally the proud name of their breed. The rams were in much demand overseas, and Australia had been fortunate in recent years in acquiring several high-class sheep from this stud.

Our late Sovereign and farmer King's interest in farming was not confined to events that met the public eye. It was more personal—more intimate. He had an ingrained love for a good beast, be it Shorthorn, Hereford, Devon, or Angus. He had a love for a good horse and a good job of farming. He took a lively interest in the Royal farms of Windsor, Sandringham, and Balmoral, and when away from them was always anxious to receive periodical reports from his land stewards. On his return he was soon inspecting the farms and discussing plans for the future. King George's sons, on their ambassadorial tours of the Empire, kept him in constant touch with the stock and land developments in each Dominion. It was in these personal considerations and in his intimate knowledge of the progress of his subjects and concern for their welfare that the King shone as Squire, as Lord of the Manor.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF JUNE IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	June.	No. of Years' Records.	June, 1936.	June, 1935.		June.	No. of Years' Records.	June, 1936.	June, 1935.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	1·63	35	3·96	0·57	Clermont	1·67	65	2·51	1·27
Cairns	2·80	54	8·12	1·89	Gindie	1·44	37	..	0·78
Cardwell	2·03	64	2·82	2·41	Springsure	1·77	67	1·91	1·16
Cooktown	1·98	60	4·29	1·38					
Herberton	1·14	50	2·68	0·86					
Ingham	2·36	44	4·50	2·49					
Innisfail	7·16	55	13·64	7·11					
Mossman Mill ..	2·22	23	9·56	5·40	*Darling Downs.*				
Townsville	1·32	65	4·90	0·40					
					Dalby	1·67	66	1·56	0·13
Central Coast.					Emu Vale	1·50	40	1·27	0·07
					Hermitage	1·74	30	..	0·03
Ayr	1·42	49	5·37	..	Jimbour	1·66	48	0·79	0·07
Bowen	1·59	65	5·66	0·07	Miles	1·78	51	1·29	0·13
Charters Towers ..	1·25	54	5·23	1·15	Stanthorpe	1·92	63	1·27	0·44
Mackay	2·62	65	10·31	0·68	Toowoomba ..	2·39	64	1·64	0·18
Proserpine	3·17	33	11·44	0·83	Warwick	1·74	71	1·68	0·20
St. Lawrence ..	2·45	65	6·39	0·46					
South Coast.									
					Maranoa.				
Biggenden	2·16	37	5·48	..					
Bundaberg	2·84	53	5·23	0·52					
Brisbane	2·71	85	1·90	0·06	Roma	1·57	62	1·29	0·38
Caboolture	2·69	49	2·17	..					
Childers	2·46	41	3·90	0·12					
Crohamhurst	4·57	43	4·57	0·46					
Esk	2·22	49	2·02	0·05					
Gayndah	1·81	65	3·07	..					
Gympie	2·66	66	3·65	0·11	*State Farms, &c.*				
Kilkivan	2·10	57	3·47	0·05					
Maryborough ..	2·99	65	4·61	0·02	Bungeworgoral ..	1·30	22	1·26	0·07
Nambour	3·72	40	4·86	0·03	Gatton College ..	1·82	37	1·96	0·08
Nanango	1·98	54	2·13	..	Kairi	1·46	22	..	..
Rockhampton ..	2·55	65	4·67	0·40	Mackay Sugar Experiment Station	2·31	39	9·90	0·80
Woodford	2·90	49	2·57	0·04					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—JUNE, 1936.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Atmospheric Pressure. Mean at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·96	77	67	84	2	52	30	429	11
Herberton	..	68	53	78	1	30	29	268	16
Rockhampton	30·12	72	56	82	6	40	25	467	9
Brisbane	30·16	68	51	79	5	42	28	190	8
Darling Downs.									
Dalby	30·18	65	41	79	5	30	16, 30	156	7
Stanthorpe	60	60	34	72	5	23	16	127	7
Toowoomba	..	63	43	75	5	31	15	164	5
Mid-Interior.									
Georgetown	30·01	79	59	88	4, 5	36	28	156	6
Longreach	30·15	71	46	81	11	31	24, 25	69	3
Mitchell	30·20	65	38	80	4	28	16, 17	143	6
Western									
Burketown	30·04	79	57	88	10	45	24	26	2
Boulia	30·16	70	46	85	10	39	17, 25, 26	4	1
Thargomindah	30·21	63	40	76	10, 11	31	16	103	1

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	August, 1936.		September 1936.		Aug., 1936.	Sept. 1936.
	Rises.	Sets.	Rises.	Sets.	MOONRISE. Rises.	Rises.
					p.m.	p.m.
1	6·35	5·21	6·7	5·37	3·26	5·23
2	6·34	5·22	6·6	5·37	4·29	6·28
3	6·33	5·23	6·5	5·38	5·33	7·34
4	6·33	5·23	6·3	5·38	6·38	8·42
5	6·32	5·24	6·2	5·39	7·41	9·49
6	6·31	5·25	6·1	5·39	8·44	10·56
7	6·31	5·25	5·59	5·40	9·47	..
						a.m.
8	6·30	5·26	5·58	5·40	10·56	12·1
9	6·29	5·26	5·57	5·41	..	1·1
					a.m.	
10	6·28	5·26	5·56	5·41	12·4	1·56
11	6·28	5·27	5·55	5·42	1·5	2·43
12	6·27	5·27	5·53	5·42	2·8	3·24
13	6·26	5·28	5·52	5·43	3·5	3·53
14	6·25	5·28	5·51	5·43	3·59	4·34
15	6·24	5·28	5·50	5·44	4·44	5·7
16	6·23	5·29	5·49	5·44	5·25	5·38
17	6·22	5·29	5·48	5·45	6·1	6·8
18	6·21	5·30	5·47	5·45	6·33	6·39
19	6·20	5·30	5·45	5·45	7·5	7·14
20	6·19	5·31	5·44	5·46	7·36	7·52
21	6·18	5·31	5·43	5·46	8·9	8·30
22	6·17	5·32	5·42	5·47	8·41	9·15
23	6·16	5·32	5·41	5·47	9·15	10·4
24	6·15	5·33	5·40	5·47	9·52	10·38
25	6·14	5·33	5·39	5·48	10·33	11·55
						p.m.
26	6·13	5·34	5·38	5·48	11·21	12.55
					p.m.	
27	6·12	5·34	5·37	5·49	12·13	1·59
28	6·11	5·35	5·36	5·49	1·10	3·2
29	6·10	5·35		5·50	2·9	4·7
30	6·9	5·36	5·35	5·50	3·13	5·13
31	6·8	5·36	5·34		4·17	

Phases of the Moon, Occultations, &c.

3 Aug.,	○	Full Moon	1 47 p.m.
10 „	☽	Last Quarter	6 59 a.m.
17 „	●	New Moon	1 21 p.m.
25 „	☾	First Quarter	3 49 p.m.

Perigee, 7th August, at 1.48 a.m.

Apogee, 22nd August, at 7.12 p.m.

On the 15th Uranus will become stationary amongst the stars of Aries.

On the same date at midnight an attractive picture will be formed by the nearness of Mars to the Moon in a narrow sickle-shape.

On the 17th the planets Mercury and Neptune will be apparently within a degree of one another, but the orbit of Neptune being 2,791,750,000 miles from the Sun and that of Mercury only 35,958,000 their real distance apart will be more like 2,755,792,000 miles.

On the 23rd Venus and Neptune will apparently be within half a degree of one another, but the enormous distance of Neptune's orbit from the Sun, as quoted above, and that of Venus being 67,190,000, they will in reality be 2,791,750,000 miles apart.

On the 26th when Scorpio, head inclined, is going westward Jupiter and the Moon will be seen near Alpha Scorpii (Antares) the brightest star in the constellation. At 6 p.m. Jupiter will be 2 degrees northward of the Moon.

Mercury rises at 7·10 a.m., 35 minutes after the Sun and sets at 5·58 p.m., 37 minutes after it on the 1st; on the 15th it rises at 7·27 a.m., 1 hour 3 minutes after the Sun and sets at 6·59 p.m., 1 hour 31 minutes after it.

Venus rises at 7·11 a.m., 36 minutes after the Sun and sets at 6·1 p.m., 40 minutes after it on the 1st; on the 15th it rises at 7·10 a.m., 46 minutes after the Sun and sets at 6·26 p.m., 58 minutes after it.

Mars rises at 5·54 a.m., 51 minutes before the Sun and sets at 4·12 p.m., 1 hour 9 minutes before it; on the 15th it rises at 5·22 a.m., 1 hour 2 minutes before the Sun and sets at 4·0 p.m., 1 hour 28 minutes before it.

Jupiter rises at 1·15 p.m. and sets at 3·1 a.m. on the 1st; on the 15th it rises at 1·23 p.m. and sets at 1·1 a.m.

Saturn rises at 8·32 a.m. and sets at 9·4 p.m. on the 1st; on the 15th it rises at 7·34 a.m. and sets at 8·6 p.m.

During this month the Southern Cross will be on its downward path towards the west during the evening hours. It will reach its extreme western point about 10 p.m. on the 1st and about 8 p.m. on the 31st, and being horizontal it will be at a hight above the horizon equal to the latitude of the place where the observer is situated.

1 Sept.	○	Full Moon	10 37 p.m.
8 „	☽	Last Quarter	1 13 p.m.
16 „	●	New Moon	3 41 a.m.
24 „	☾	First Quarter	8 12 a.m.

Perigee, 3rd September, at 8.48 p.m.

Apogee, 19th September, at 10.42 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

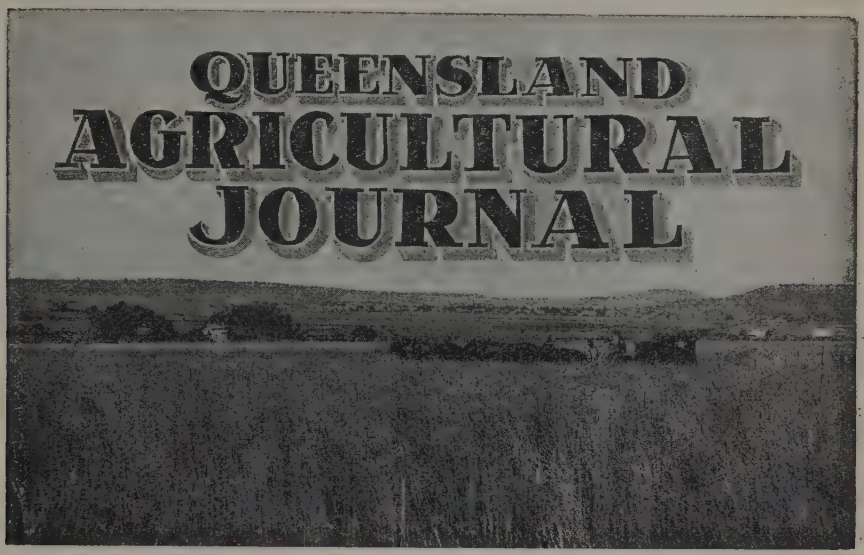
The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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VOL. XLVI. 1 SEPTEMBER, 1936. PART 3

Event and Comment

An Imperial Show.

"THIS is not only a Queensland Show; it is far more than that—it is an Imperial Show," said His Excellency the Governor, Sir Leslie Wilson, in opening the Brisbane Exhibition officially in the presence of a large gathering of representative citizens. They showed, continued the Governor, that day at the Exhibition, and in many other ways, an Empire bound together by ties of loyalty, by ties of affection to the Throne, by an identity of interests, and by a similarity of customs, and, above all, an Empire which stood for liberty. No such Empire had been known in the world before—not even in the days long since gone by, even in the days of the great Roman Empire. The Association's address had quoted the beautiful words of Brunton Stephens, at the opening of the first Exhibition held here in 1876—exactly sixty years ago. They had progressed since that year, due to the stout hearts, enterprise, and courage, in the early years, of the great pioneers of the past, but if ever there was a State blessed by Divine Providence in all its natural wealth, it was Queensland. Let them, therefore, put to the best use for the benefit of the greatest number, the good gifts with which they were blessed, and let each one in every sphere of life devote his life to this great aim.

The Future of the Chilled Beef Industry.

THE Meat Hall, in which was displayed a complete range of animal products and derivatives, was one of the outstanding features of the Brisbane Show—one of the greatest events of Queensland's agricultural year. The Hall was opened officially by the Premier, Hon. W. Forgan Smith, who, in the course of a notable address to a large assemblage of graziers and others interested in the development of our export trade,

said that since the war South American countries had, with chilled beef, virtually captured the English import trade, leaving little demand for frozen beef, and, at that, only on low price levels.

That was the state of affairs when the Ottawa Conference was held in 1932, and it was clear to him, when he visited England in 1934, that the Ottawa Agreement, so far as it applied to beef, had brought no improvement to the unfavourable situation of Australian cattle producers.

During 1935 negotiations for a long-term beef agreement were continued in London between the United Kingdom and Australian Governments. Negotiations were resumed this year, and his recent visit to England afforded him the opportunity of further discussing the matter with the British authorities, and of collaborating with the Federal Ministers then in London.

It had, in fact, always been his opinion that to arrest the development of the cattle industry would mean, in effect, that little or no further development could be expected in the vast areas of cattle country in Queensland, the Northern Territory, and North-western Australia, and the more intensive use of these areas was admittedly to-day one of Australia's most outstanding problems.

It had been claimed by people with various interests in Argentina that with respect to beef Australia could never become a strong competitor in the markets of the United Kingdom, into which South American countries export almost 5,500,000 quarters of chilled beef annually, as compared with about 1,000,000 quarters exported from Australia, which, until recently, were shipped as frozen beef. Such claims, however, are made after Australian beef producers have suffered more or less "bankrupt" prices for frozen beef during the last fifteen years, and who, in endeavouring more recently to land chilled beef on English markets, have had to overcome many difficulties.

It was his firm belief that, given certain circumstances, Australia could become a much more important supplier of beef to English markets than she had been in the past, and export meat of a quality and in a condition suitable to English consumers.

The first essential is that as the quality is improved to the desired standard the beef must be exported chilled instead of frozen, and that chilled beef should be aboard ship for the least possible time.

Under present transport arrangements the bulk of chilled beef exports—the most highly perishable product we export—are the first Australian loading, and are required to traverse the equivalent of almost half the distance between Argentina and England before it actually leaves the Australian coast. This long voyage naturally depreciates the appearance of the beef when offered for sale in English markets.

In examining the Australian exports of beef, pork, mutton, lamb, butter, and cheese, he found that of the total of those refrigerated products—some 320,000 tons—95 per cent. is shipped from the three Eastern States, and 44 per cent. from Queensland alone.

Continuing, the Premier said: "There is, of course, not only an inter-relationship between the producing interests of these various commodities, but there is an interdependence, inasmuch as one class of product assists the other in securing adequate transport tonnage. In my opinion, therefore, there is an obvious answer to the question of the means of furthering the joint meat and butter interests of Eastern Australia, which is that, instead of the general route

for vessels trading between Australia and the United Kingdom being south-about, a sufficient number of vessels to provide a weekly service for refrigerated produce and general cargo should come out to Australia via Torres Strait, making Melbourne the final outward port, from where, also, the homeward voyage via Torres Strait should begin. I am aware, of course, that such a service would require sufficient depth at the Queensland loading ports, and that perhaps, also, so as to reduce the loading time to a minimum, consideration would need to be given to some plan of centralising the loading to a fewer number of ports, but these difficulties are not insuperable. The chief consideration is that a service via Torres Strait would not only serve the requirements of the shippers of refrigerated produce in the Eastern States, but it would make possible, and so far as I can see will be the only means of making possible, the proper development of the areas of the northern belt of Australia. In beef production the difficulties of distance between Australia and the United Kingdom would be overcome immediately, and with that difficulty out of the way it is possible to visualise a complete economic reorganisation of beef production, as between the functions of breeding and fattening. While we have vast breeding areas, undoubtedly we also possess, in many of our reliable coastal areas, country highly suitable for the fattening of cattle, and this subject at the present time is being studied scientifically and with promising results."

Mr. Forgan Smith added that the undeveloped area of Northern Australia was a matter of concern, not only to Australians but to the people of the whole Empire.

Confidence in the State.

"CONFIDENCE spells prosperity; distrust generally means adversity." That was the keynote of an impressive speech by the Governor, Sir Leslie Wilson, at an important Show week function. Some people, he added, thinking on the great problems confronting the world to-day, were inclined to believe they were impossible of solution. There was nothing impossible in this world, and he would like to see the word "impossible" removed from the dictionary of every person in a country like Queensland.

Addressing the same gathering, the Minister for Agriculture and Stock, Hon. Frank W. Bulcock, said that this year's Show struck a note that was in the ascendant in the State to-day—a note of confidence. When His Excellency had said that nothing was impossible his own mind went back over the history and development of agriculture in Australia, and he agreed that nothing was impossible. Things that were regarded as incapable of attainment in other years were now accomplished facts. Only a few years ago wheat was being imported; to-day Australia was a granary contributing to world supplies. Until fairly recently the cry that Australia could not ship chilled beef was ringing in their ears; yet to-day Australia was shipping chilled beef equal to anything finding its way to the Smithfield market.

They could not hope for an expansion of land consciousness unless they could show what the land was capable of producing. The most potent factor in developing that consciousness was the splendid array they saw on every side that day. Some people had no confidence in anything. Some decried agriculture, but it was worth remarking that both His Excellency's son and the son of the Premier were training for careers on the land.

The Species of Diplodia Affecting Forest Trees in Queensland.

H. E. YOUNG, M.Sc.Agr., Assistant Plant Pathologist.

SINCE the planting of exotic species of *Pinus* on a plantation scale was first commenced in Queensland the most important fungus parasites on the living trees have been relegated to the genus *Diplodia*. Two distinct species have been identified, and the nature of the injury caused by them is typically the same.

The first definite record of the disease caused by one of these fungi was in August, 1930, when the death of the leading shoots of *Pinus radiata*, at Benarkin, in the Brisbane Valley, was reported by R. B. Morwood, Plant Pathologist, as being caused by a species of *Diplodia*. In May of the previous year what may have been an earlier observation of the disease was made in the same locality when a dieback of the leading shoots was noted but no pathological examination made.

The next mention of the disease was in December, 1932, when, following a severe hailstorm, there was a heavy incidence of the infection. Since this date there has been a recurrence of the trouble during the warmer months of each year. It has appeared in the meantime at Imbil, in the Mary Valley, where, again, the chief host is *Pinus radiata*, the same fungus being associated with the lesions.

In September, 1934, a tree affected with *Diplodia* dieback was found at the forestry plantation at Beerwah, and in October a number of trees succumbed to the disease. Affected trees were found throughout the summer. The fungus associated with the trouble in this locality proved to be a species of *Diplodia* which differed from that found on *Pinus radiata* in other localities, and so far the attack of *Pinus* spp. by this particular pathogen has been confined to Beerwah.

Owing to the possible extension of the damage caused by these two fungi, considerable attention has been focussed on the disease during the last two years.

Identification of the Fungi Associated with Dieback.

Specimens of diseased material and pure cultures of the fungi associated with the two types of dieback were forwarded to the Imperial Mycological Institute, and the organisms were kindly identified by S. F. Ashby. The species associated with "dieback" of *Pinus radiata* proved to be *Diplodia pinea* Desm. Kickx., whilst that associated with dieback of *Pinus tæda* and *P. caribæa* at Beerwah closely resembled *Diplodia natalensis* Pole-Evans. Although the latter fungus has not previously been recorded from *Pinus*, later observations will show that there does not appear to be much doubt as to this being its rightful designation.

Proof of Pathogenicity of the Fungi Associated with Dieback.

Specimens of *Pinus insularis, P. patula, P. tæda,* and *P. caribæa* have been successfully inoculated with pure cultures of *Diplodia pinea* isolated from *P. radiata* (Table 1). The inoculations resulted in the

production of symptoms typical of dieback, followed by death of the plants. The usual inoculation procedure adopted was to take a young, actively growing culture in a petri dish, and having cleaned with alcohol the site where the inoculation was to be carried out the tree was wounded with a sterile scalpel. The scar was approximately 1 inch long and $\frac{1}{4}$ inch wide.



Plate 131.

Left.—Healthy plant of *Pinus caribœa.*

Right.—*Pinus caribœa* plant artificially inoculated with *Diplodia pinea,* resulting in dieback and finally death.

A piece of the inoculum was then removed from the edge of plate culture, and, aseptic precautions being observed, it was placed on the wound. A swab of damp, sterile cotton wool was then placed over

the inoculated wound and the whole wrapped with a piece of tinfoil. After three days the tinfoil and wool were removed. Symptoms of dieback usually developed within three weeks, and when the plant or part of it had succumbed (Plate 131), pycnidia of the fungus used as an inoculum developed on the dead wood. The fungus was then reisolated in the usual manner.

TABLE 1.

INOCULATIONS WITH DIPLODIA PINEA DESM. KICKX.

Tree Species.	GLASSHOUSE.			OPEN AIR.		
	Dead.	Dieback.	Unaffected.	Dead.	Dieback.	Unaffected.
P. taeda	7	..	..	..	3	..
P. caribaea	7	..	..	..	3	..
P. patula	7	..	..	2	1	..
P. insularis	7	..	..	2	1	..

TABLE 2.

INOCULATIONS WITH DIPLODIA NATALENSIS POLE-EVANS.

(Strain isolated from *Pinus tæda*.)

Tree Species.	GLASSHOUSE.			OPEN AIR.		
	Dead.	Dieback.	Unaffected.	Dead.	Dieback.	Unaffected.
P. taeda	7	..	..	1	..	2
P. caribaea	7	..	..	..	..	3

The experiments were then repeated using *P. tæda* and *P. caribæa* as hosts, and *Diplodia natalensis* as the inoculum, and similar results were obtained with this organism (Table 2).

The tests were carried out with pine seedlings approximately 18 inches in height. Seven plants of each of the species listed were inoculated with each fungus under glasshouse conditions, resulting in the death of all the inoculated plants.

A further three plants of each of the species mentioned were inoculated with *D. pinea* and the inoculated plants placed in open air conditions in full sunlight. The damage in these instances was not so severe as under the humid glasshouse conditions. All the *Pinus tæda* and *P. caribæa* plants exhibited dieback of the plant above the point of inoculation, and in some cases almost down to ground level, but the plants produced healthy shoots again below the area of "dieback." Pycnidia were formed on the dead tissues. Two of the *P. patula* plants succumbed and one suffered only from dieback, from which it recovered by making new growth from below the infected area. In the case of *P. insularis* two of the inoculated trees died and one recovered, as did the *P. patula* plant.

In addition, three trees each of *P. caribæa* and *P. tæda* were inoculated with *Diplodia natalensis*, which was isolated from an infected *P. tæda* tree at Beerwah. Only one of the inoculated plants was affected. This decrease in the severity of the attack in the open air was probably due to the low humidities prevailing at the time.

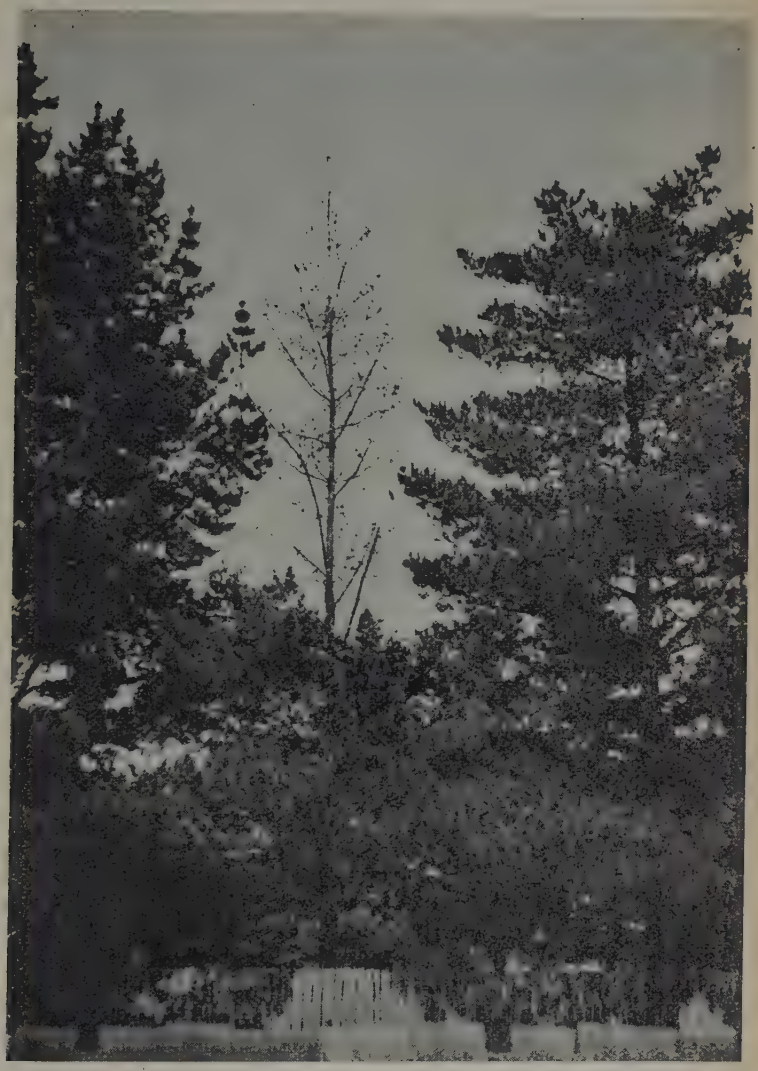


Plate 132.

Pinus radiata tree affected with dieback caused by *Diplodia pinea*. Hampton, Queensland.

Appearance of the Disease as caused by Diplodia pinea Desm. Kickx.

The disease appears in the summer months and is manifested by a bronzing and finally browning of the needles on the affected area, which is usually a leader or terminal shoot of a lateral branch. The

shoot then wilts and dies, giving rise to the popular name of dieback. The trouble spreads downwards from the leader attacking the branches of the nearest whorl below and so on down the tree. (Plate 132.) In many cases, however, the fungus is confined to the terminal shoot and does not extend beyond it. If the attack commences in a lateral branch the fungus on reaching the trunk of the tree usually first attacks the other branches in the same whorl before invading other whorls to which it makes its way by penetrating the tissues both up and down the trunk. A number of cases have been noted in which the needles were the initial point of attack; from the needles the fungus makes its way into the branches and may then invade the remainder of the tree.

A severe hailstorm which bruises and cuts the bark of the tree is often, in districts subject to dieback, followed by that complaint, the hail providing openings through which the fungus can make its entry. The scarring is chiefly on the more exposed parts of the trees, such as the leaders and ends of the lateral branches, and accordingly the dieback in these cases makes its first appearance in those parts of the tree. Suitable weather conditions following the hailstorm are, of course, a necessary adjunct to the appearance of the disease.

In many cases the tree may produce new shoots from below the infected area and continue its healthy growth, but usually where infected tissue is present on the tree the disease will again become active and cause further dieback. In the case of the more susceptible trees the dieback extends until the tree is killed. Sometimes, however, only a severe needle cast is caused, and new needles replace them, and the tree regains its vigour. Where a dieback is present, it would appear possible that the whipping of healthy tissue of neighbouring trees with this diseased wood would inoculate the previously uninfected tissues.

Severely affected trees exude much resin from cracks in the bark up the trunks. On account of this the trunk often has a greyish-white appearance.

Trees from ten feet in height and upwards appear to be most susceptible to the condition, those of smaller size being infrequently attacked. In such small trees there is, in ordinary circumstances, no closure of the crowns, consequently the trees are better ventilated and the sun reaches most parts of them. This produces drier conditions than are suitable for spore germination and fungus growth.

On examination of a dying branch or leader it will be seen on cutting the bark that there is a browning of the cambium and the rest of the cortex. This colouration gradually darkens until, when the twig

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DESCRIPTION OF PLATE 133.

Diagrammatic drawing of a section of a *Pinus radiata* stem illustrating infection by *Diplodia pinea*.

(*a*) Ostiole of pycndium.
(*b*) Cuticle.
(*c*) Parenchyma.
(*d*) Resin passage.
(*e*) Fungal hyphæ.
(*f*) Phlœm.
(*g*) Cambium.
(*h*) Xylem.
(*i*) Medullary ray.
(*j*) Epithelial cells of resin passage.
(*k*) Developing spore.
(*l*) Uniseptate spores.
(*m*) Unilocular spore.

x 150.

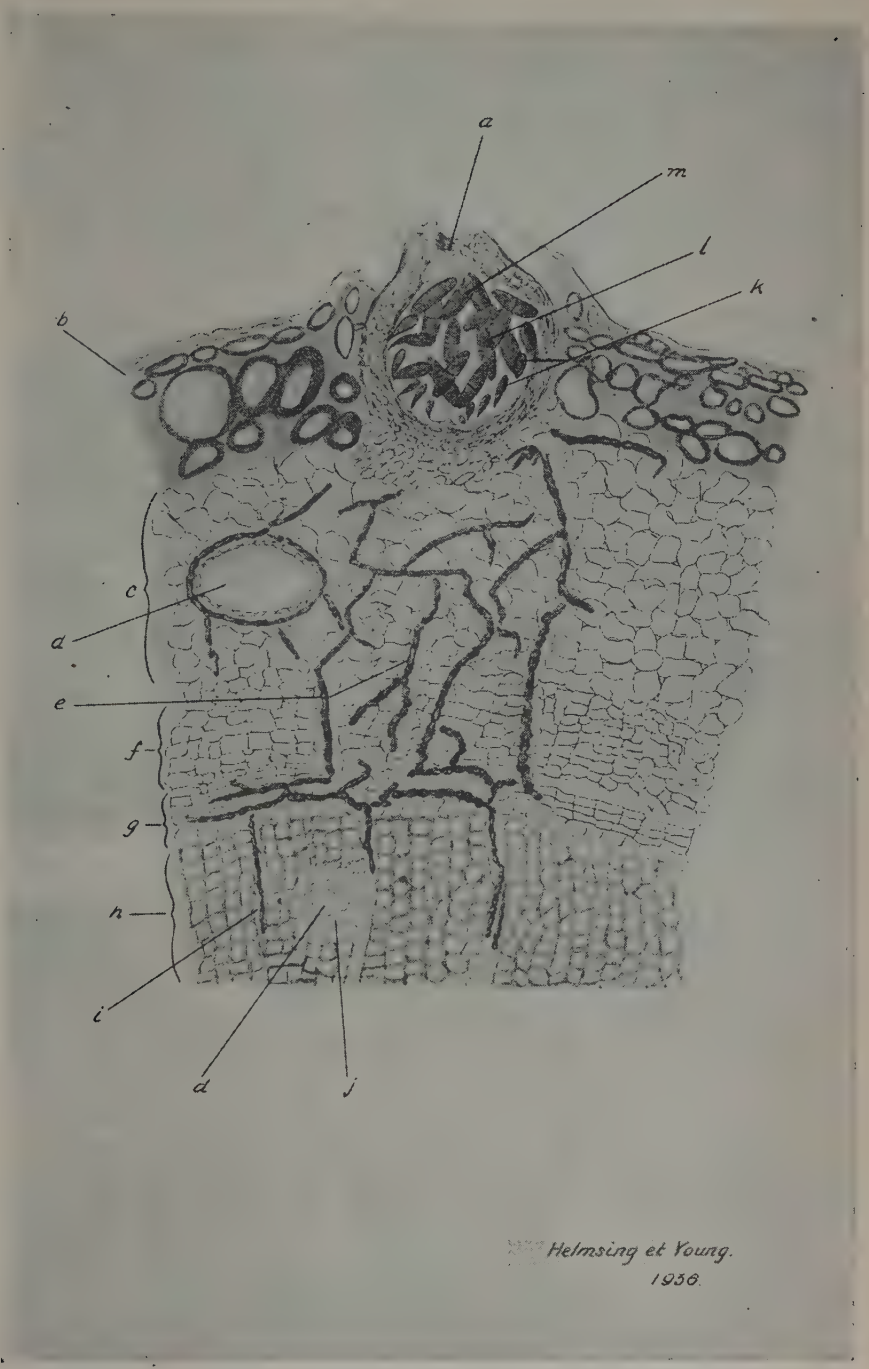


Plate 133.

is dead, the cortical tissues are black and even the wood below has a blue-black tint, and the pith may become darkened. In sections the fungal hyphæ may be traced from the cambium through the medullary rays to the pith. (Plate 133.) Small pustules appear bursting through the bark on the dead wood in the same season, but no pustules appear on those parts of the tree which are not quite dead. Pustules occur with less frequency on the needles, but when this does happen the pustules on bursting through, split the cuticle longitudinally. Both fungus and pustules are frequently to be found growing saprophytically on the prunings on the ground beneath the trees, and also to a lesser extent on dead suppressed lateral branches.

Appearance of the Disease as Caused by Diplodia natalensis Pole-Evans.

In the case of the form of dieback so far confined to Beerwah, some of the affected trees, when the trouble was first noted, were already dead; in other cases an odd lateral branch or a leader was dead and red-brown in colour. In specimens illustrating the earlier stages of the disease the foliage of the affected parts had a bronzy-green tint, and darker coloured water-soaked looking areas were apparent in the needles which were dying from the fascicle and towards the tips.

As in the case of dieback caused by *Diplodia pinea* brown to blackish discolouration was apparent on lifting the bark, and in more advanced cases where the wood was dead incipient pycnidia were found, and in the case of a tree which had evidently been dead for some weeks fully developed pycnidia macroscopically similar to those produced by *Diplodia pinea* at Benarkin and other places were present. The pith was, in a number of instances, of a darker colour than normal, and hyphæ could be traced from the pith through the medullary rays to the cortex.

In all cases it was the older foliage which suffered first, and because this outbreak occurred in early spring during a period of abnormally warm and humid weather for that time of the year, it was postulated that the pathogen had probably been working slowly through the tree or remaining dormant therein until the conditions occurred which suited its active development.

From observations made it was ascertained that the time elapsing between the first appearance of the symptoms and the death of the trees was no more than six weeks. In the great majority of cases the infection commenced on the south-western side of the trees, which is that sheltered from the drying affects of the sun and the prevailing north-easterly winds.

Close examination of affected trees revealed no major mechanical injuries by which the pathogen could have made its entry except in one or two isolated cases later in the summer, where in larger trees of *Pinus tæda* the entry was traced to pruning scars.

The greater percentage of trees affected were from seven to eleven feet in height. The species affected were *Pinus tæda* and *Pinus caribæa,* but the latter was affected to a lesser extent and showed indications of resistance to the dieback organism.

A number of trees, on removal of the affected parts, recovered and made normal growth, whilst others did not respond to the treatment but became fully affected. In the latter case, it was assumed that all

affected material had not been removed. A number of trees from which damaged foliage had been pruned showed healthy wood and no darkening of the cambium, but the pith was darker than normal. This seemed to indicate that the fungus might in certain cases work through the pith of the tree in advance of the infected cambium. Pure cultures of the fungus were isolated from the pith and thus supported this view.

The fungus has been found on dead pine branches on the ground and on trees which have been infected whilst living. But the cleaning of the forest floor of such dead material does not at present appear essential.

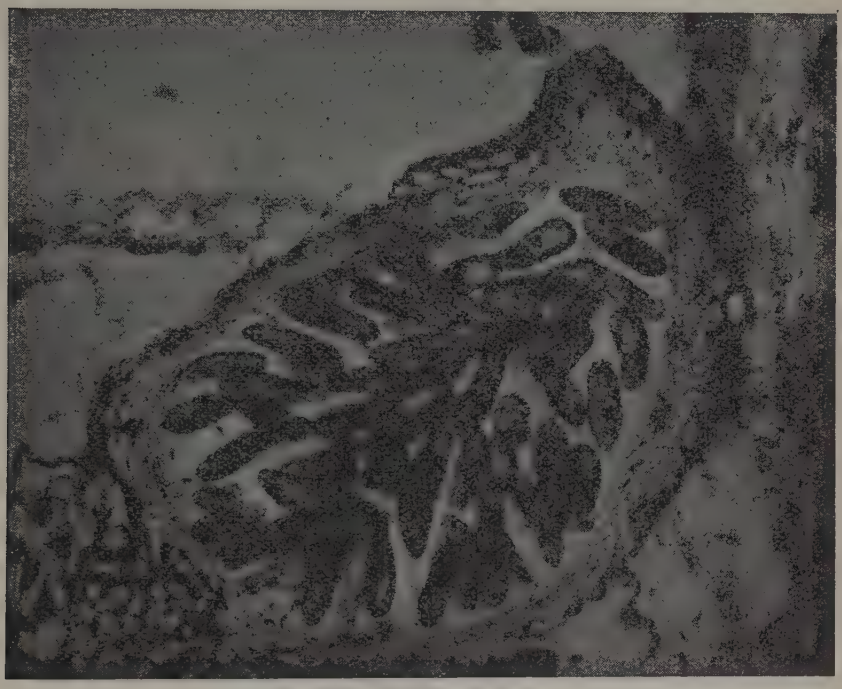


Plate 134.

Microphotograph of pycnidium of *Diplodia pinea* on *Pinus radiata*. K3 filter. Exposure 5 seconds. Verichrome film pack. x 300.

Species Attacked.

In 1907 *Diplodia pinea* Desm. Kickx. was noted as causing a dieback in *Pinus radiata* trees in New Zealand, and the same fungus has also caused considerable damage to plantations in South Africa, where curtailments of planting operations with that species have in some places been brought about by this fungus.

The most important host species in Australia for *Diplodia pinea* is *Pinus radiata*. Other species are also attacked but to a lesser extent. As already mentioned, this is the chief cause of dieback in *Pinus radiata* plantations in Queensland. Other species attacked in Queensland are:— *P. pinaster, P. patula, P. tæda,* and *Cupressus sempervirens. Pinus insularis* has been artificially infected, but has not yet been recorded

as being attacked in the field. The same organism has been isolated by the author from *P. radiata, P. longifolia, P. caribæa, P. coulteri,* and *P. pinaster* from Northern New South Wales.

The species attached by *Diplodia natalensis* are *P. tæda* and *P. caribæa,* the former being the more susceptible of the two. The only locality in which this organism has been recorded from *Pinus* spp. is an isolated area at Beerwah, where prompt control measures appear to have cleared up the trouble.

Description of the Queensland Strain of Diplodia pinea.

Perithecia globose, carbonaceous, erumpent, about 300 microns in diameter, spores 33 to 45 by 11 to 18 microns, oblong with rounded ends, at first unilocular and yellow-brown, but later one septate sometimes somewhat constricted at the septum and dark-brown. Mycelia brown 3 to 4 microns in diameter. Habitat in bark, needles, medullary rays, and pith of *Pinus* spp. (Plate 134.)

Cultural Characteristics.

It grows rapidly on most ordinary culture media. On potato-dextrose-agar the mycelium is at first white and later turns black, and stains the media to the same colour. Pycnidia containing spores form after the cultures have been left for some weeks, and are usually plentiful on the dead wood of *Pinus radiata* trees in infected areas.

The optimum temperature for growth is 27·0° C. Growth occurs at a minimum temperature of 10·0° C. and at a maximum temperature of 39·0° C. The growth rate decreases much more rapidly from the optimum temperature to the maximum than it does to the minimum. Brown's Media *a* was used in order to regulate the quick growth of the fungus to a speed suitable for measurement.

The fungus is easily isolated in pure culture from the pith or cambial regions of infected areas. Single spore isolations are also successful.

Weather Conditions.

The weather conditions during the first authentic attack in December, 1932, were as follows:—

5th December—Severe hailstorm in the evening.	
Mean maximum temperature—5th-31st December	32° C.
Mean minimum temperature—5th-31st December	14° C.
Mean relative humidity—5th-31st December ..	40 per cent.
Rainfall—5th-31st December	256 points

Rain fell on six days of the twenty-six, and the period was marked by cloudy days with the rainfall occurring as storms.

The attack was first noticed on the 22nd December, and it is assumed that the fungus entered the trees after damage had been done by the hailstorm which severely bruised and scarred the trees on 5th December. On referring to Plate 134 and consulting Curve B on Plate 135 it will be seen that the temperature range for the period is well within that which is productive of vigorous growth of the parasite.

Control Measures Adopted.

All diseased trees are removed, attention being paid to this during thinning operations as well as at other times.

The planting of *Pinus radiata* and *P. pinaster* has been stopped, as these species appear to be very susceptible to this and other troubles in Queensland, and are likely to act as a reservoir for the infection of other species which have proved to be less subject to attack.

It is questionable whether the removal of prunings from the plantation floor in infected areas is economically practicable. Such prunings are usually infected with the pathogen, which spores freely on them. However, being on the ground, the spores are not as liable to cause infection as are those on the standing trees.

Insect Associations.

In some districts, notably in Northern New South Wales and the Pechey district in Queensland, a scale insect, usually referred to as *Chermes* sp., but generally regarded as belonging to the family *Adelgidæ*, is found chiefly on *Pinus radiata*. It does a considerable amount of damage by sucking the plant juices causing wilting, and in some cases actual death of the tree. The insect frequents the thin barked parts of the plant, and accordingly is found abundantly on the growing shoots and just below them. In trees badly infested, however, the whole trunk may be parasitized, and as the insects are covered with a white waxy coat the tree is given a greyish appearance. Some trees recover from the attack and may become completely free of the insects, but usually the infestation continues and the vigour of the tree is materially affected.

The localities infested with *Chermes* are also places in which *Diplodia pinea* occurs, and while both may and do occur in the absence of each other it would appear possible that, in localities where both occur, the fungus may be aided in its destructive work by the presence of the insect. The insect, while feeding, wounds the tree, and accordingly makes available possible entries for fungus parasites, and the spores of *D. pinea* being very plentiful, owing to the heavy incidence of infection in some areas, the tree may be readily infected. Trees severely affected by *Chermes* wilt in the terminal shoots, and in this depressed condition are more liable to fungus attack. The dead wood which results from this wilting is also very susceptible to invasion. *D. pinea* grows vigorously as a saprophyte on dead branches, &c., of *Pinus* spp., and is found very abundantly on prunings and droppings of pine trees in infected areas. A dead infected shoot on a living tree, particularly when the remainder of the tree has been scarred by *Chermes*, would consequently provide a suitable and contiguous source of the pathogen which then might make its way into the living tree through the insect scars as already described.

Description of Diplodia natalensis Pole-Evans.

Diplodia natalensis was originally described by Evans as causing a decay in lemon fruits in South Africa. It occurs also in Florida, Cuba, Puerto Rico, California, and the Philippines. It is not uncommon in Queensland, causing a stem and rot in citrus fruits.

Pycnidia are usually abundant on the dead wood of citrus trees and provide reservoirs from which spores may be disseminated. The pycnidia appear during the warmer months of the year.

The fungus was described by Evans as follows:—"Pycnidia scattered, at first covered by epidermis, afterwards bursting through, black, membranous, subglobose, papillate 150-180 microns in diameter. Spores elliptical, one septate, not constricted at the septum, dark coloured, 24 x 15 microns. Exospore ornamented by striated bands. (Plate 136.) On fruits of all citrus varieties from Natal."

The strain isolated from *Pinus tæda* and *Pinus caribæa* at Beerwah agreed closely with this description excepting that the spore measurements differed a little. The Beerwah strain had slightly narrower spores, the measurements being 20-29 x 13-15 microns, whilst those from an authentic culture of *D. natalensis* supplied to the Imperial Mycological Institute at Kew by Dr. Doidge (Principal Plant Pathologist, Union of South Africa), were 22-29 x 14-16 microns. These details were supplied by S. F. Ashby, who also states that the nearest *Diplodia* recorded from species of *Pinus* is *Diplodia sapinea* (Fr.) Fckl., of which the spores are brown (not opaque), septate, nonstriate, and not constricted, and 22-27 x 11-13 microns (mostly 23-26 x 13 microns), being about the same length but narrower. However, Ashby cannot identify this species with that under discussion, and there appears to be little doubt that the fungus is *Diplodia natalensis*.

Cultural Characteristics.

On most culture media the strain of *D. natalensis* being considered grows very rapidly, producing at first a light to greyish mycelium, which later becomes dark and almost black. Pycnidia and spores are produced in old cultures, the fungus fructifying readily on potato-dextrose-agar slants kept at room temperature.

The optimum temperature for growth is 31·5° C., the minimum temperature is 12·0° C., and the maximum temperature 41·0° C. (Plate 135.) In order to investigate the temperature requirements Brown's Media *a* was used. In richer media the mycelium covered the plates too rapidly for convenient measurement.

Isolation.

Pure cultures were readily obtained from diseased tissues of *Pinus tæda* and *Pinus caribæa*. The pith of diseased trees or infected tissue from beneath the cuticle formed satisfactory inocula. Spore isolations from spores obtained from pycnidia on diseased wood were also generally successful.

Association of "Dieback" in Pinus at Beerwah with Lemon Trees.

The Pinus trees affected in the plantation appeared to be in most cases arranged in groups with an odd individual tree scattered about the infected area. The majority of the infected trees were situated on areas which had previously been farmed. On these areas a number of lemon trees in a very unthrifty state were still present as remnants of the cultivated crops. All the living lemon trees were stag headed with only a few green shoots coming up from the base and many were completely dead. In most cases there were one or more citrus trees close

to each group of pine trees affected with dieback, and in the case of the first discovery of this particular *Diplodia* dieback in pine trees, the tree affected was situated close against the south-western side of a large, dead lemon tree. Examination of the dead wood of the lemon tree showed it to be severely affected with a fungus which produced carbonaceous pycnidia; these proved to be the pycnidia of *Diplodia natalensis*, the fungus agreeing in every way with the description of the

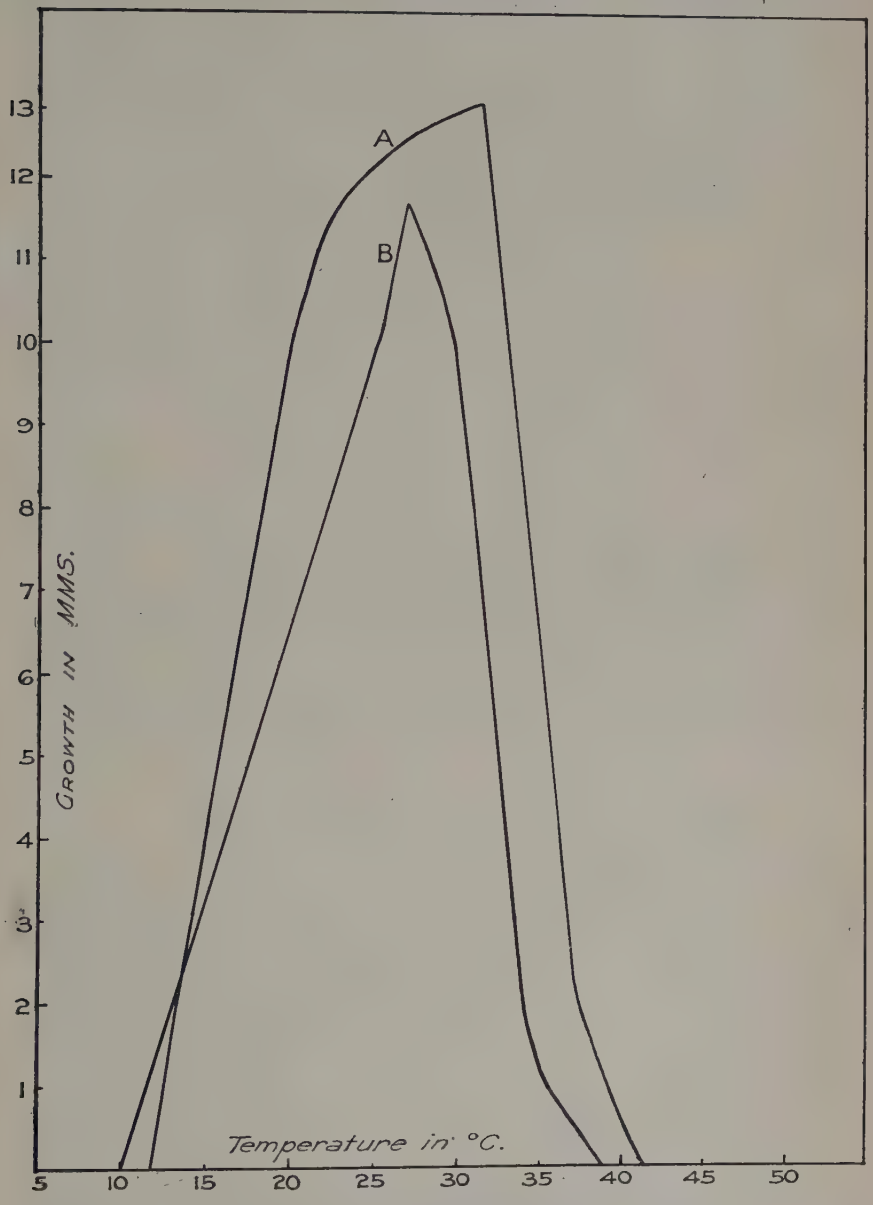


Plate 135.

Growth-temperature curves for the two species of Diplodia. A.—*Diplodia natalensis* Pole-Evans. B.—*Diplodia pinea* Desm. Kickx.

species except that a proportion of the spores were somewhat constricted at the septa. This fungus is common in Queensland, causing stem end rot of various citrus fruits. Isolations proved that the fungus was morphologically identical with that on the pine trees.

It was then thought that the citrus trees might be acting as a permanent source of infection for the pine trees, and inoculations were carried out with isolations of the *Diplodia* obtained from the lemon trees and pine trees respectively. The inoculations with the lemon *Diplodia* on *P. tæda* and *P. caribæa* (Table 3) were successful under glasshouse conditions, less so in the open air as in the previous cases. The inoculations of lemon fruits with the pine *Diplodia* also were followed with positive results. Stem end rot was produced in the latter case and dieback in the former.

TABLE 3.

INOCULATION WITH DIPLODIA NATALENSIS POLE-EVANS.

(Strain isolated from Lemon Tree.)

Tree Species.	GLASSHOUSE.			OPEN AIR.		
	Dead.	Dieback.	Unaffected.	Dead.	Dieback.	Unaffected.
P. taeda	4	..	..	1	..	1
P. caribaea	3	1	..	..	1	1

The citrus fruits were inoculated by introducing into a split, cut across the stem end of lemons, some mycelium from a pure culture of the fungus isolated from a pine tree. Limes and oranges were also used. The exteriors of the fruits were previously sterilised by washing them for five minutes in mercuric chloride solution (1:1,000). The inoculated fruits were placed in sterile vessels and incubated at 27° C. When the fruits became completely blackened, reisolations were made and the fruits were allowed to dry out, and in all cases pycnidia of the fungus isolated from the pine tree were obtained. The reisolations were identical with the original cultures.

Inoculations of lemon fruits with inoculum obtained from pure cultures isolated from diseased citrus fruits were also successful in producing the typical pycnidia.

Examinations of citrus fruits (oranges and lemons) affected with stem end rot from other districts showed them to be associated with the same fungus as that in question on pine and lemon trees at Beerwah. Pycnidia containing spores of *D. natalensis* were easily obtained by allowing the diseased fruits to dry out slowly. Pure cultures growing on potato-dextrose-agar and obtained by making isolations from the affected fruits also yielded pycnidia and spores after several weeks.

Furthermore, on plotting the positions of infected pine trees and citrus trees in the plantation at Beerwah, the association between the two was very obvious. Where there were no citrus trees in the close neighbourhood there was only a single affected pine tree. As a general rule it was found that the infected pine trees were situated in a south-westerly direction from the position of the citrus trees, and, the prevailing summer winds being from the north-east, the association was linked

up further, the direction in which the spores would be expected to be carried by air drifts being south-west. In very few cases were pine trees suffering from dieback situated on the windward side of the citrus trees.

On account of all these considerations it was decided that the citrus trees were acting as a source of infection for *Diplodia* dieback of *Pinus læda* and *Pinus caribæa* at Beerwah, the *Diplodia* in question being *Diplodia natalensis* Pole-Evans.

Weather Conditions Associated with the Incidence of "Dieback," as Caused by Diplodia natalensis.

A number of days prior to the time when the effects of the dieback were first noticed the weather had been very humid, and during the month in which the greatest damage was done, namely, October, 1934, weather data were as follows:—

Mean maximum temperature 28·0° C.

Mean minimum temperature 13·0° C.

	7.30 a.m.	11.30 a.m.	12.30 a.m.	4.30 p.m.
	Per cent.	Per cent.	Per cent.	Per cent.
Mean Relative Humidity ..	76·6	65·1	65·3	65·0
Rainfall	268 points			

Rain fell on fourteen days of the thirty-one, and the sky was generally overcast for the whole period.

On referring to the temperature relations curve for *Diplodia natalensis* (Plate 135) it will be seen that the mean maximum temperature is very close to the optimum, and the whole range was in that in which the fungus grows actively.

The overcast sky, the rainfall, and humidity, together with the temperature, should have provided suitable growing conditions for the fungus and account for the rapid onset of the disease and its vigorous development on affected trees.

Control Measures Adopted.

In order to check any further spread of the disease it was considered advisable that all infected wood should be destroyed before spores were developed and distributed. Accordingly, all dead and dying wood on living trees was pruned back into healthy wood and all the prunings burned. All trees which were considered to be past the stage at which pruning might be of value in saving the tree, such as dead and dying trees, were cut off below ground level and removed and burned.

A close watch was then instituted and each case of dieback appearing was treated on its merits as above described. In the meantime, all the citrus trees and stumps in the plantation were removed below ground level, and any living butts left in the ground were poisoned to prevent suckering.

Only isolated trees suffering from the complaint were found during the remainder of the summer and none through the winter, save an odd specimen or two which had obviously been missed in the summer patrols. A close watch is henceforth to be kept on the plantations during the danger season.

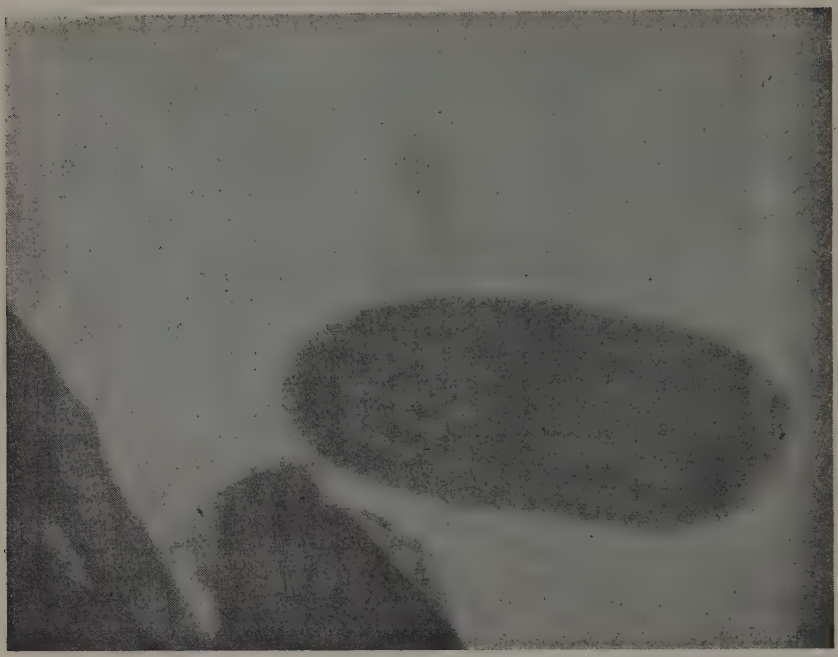


Plate 136.

Microphotograph of exosporium of spore of *Diplodia natalensis* showing striations. "Daylite" filter, exposure 20 seconds, oil immersion objective. x 1700. Verichrome film pack.

DIFFERENCES EVIDENCED BY DIPLODIA DIEBACK AS CAUSED BY D. PINEA AND D. NATALENSIS.

Diplodia pinea.	Diplodia natalensis.
Species of conifer susceptible— *P. radiata, P. pinaster, P. patula, P. longifolia, P. taeda, P. coulteri, P. caribaea, P. insularis, P. canariensis, Cupressus sempervirens.*	Species of Conifer susceptible— *P. taeda, P. caribaea.*
Speed of Development in the host— Usually slowly but in one case within three weeks.	Speed of Development in the host— Usually with rapidity taking approximately six weeks.
Distribution—General.	Distribution—Confined to Beerwah.
Association with trees not conifers— Not associated.	Association with trees not conifers— Common on citrus and other trees.
Temperature relations— Minimum 10° C. Optimum 27° C. Maximum 39° C.	Temperature relations— Minimum 12° C. Optimum 31.5° C. Maximum 41° C.
Spore measurements— 33-45 microns x 11-18 microns.	Spore measurements— 20-29 microns x 13-15 microns.
Spore markings— Exosporium plain (Figure 5).	Spore markings— Exosporium striate (Figure 6).

Botryodiplodia Theobromæ Pat.

The only other diplodia-like fungus which has as yet been recorded as a coniferous parasite in Queensland is *Botryodiplodia theobromæ* Pat. This was isolated by R. B. Morwood from the seed of Hoop Pine (*Araucaria cunninghamii*) which had failed to germinate on the seedbeds, and was also found on hoop pine seedlings which had apparently been killed by the fungus. The first record was from a forest nursery in the Kilkivan district. It has also been recorded on rotted seed from the forest nursery at Imbil.



Plate 137.

Microphotograph of spore of *Diplodia pinea* showing absence of markings. "Daylite" filter, exposure 20 seconds, oil immersion objective. x 1700. Verichrome film pack.

The fungus was kindly identified by S. F. Ashby, and may be described as follows:—Perithecia black, 200 microns in diameter, sometimes villous, stromata villous, spores 27-34 x 14-16 microns, hyaline and unilocular with thick walls, then becoming uniseptate and brown, basidia hyaline 50 microns long. It is a very widely distributed saprophyte and semi-parasite on a wide range of host plants especially within the tropics, and may occur as a wound parasite on citrus, banana, and other fruits.

Inoculations on to lemon fruits with pure cultures of the fungus produced a stem end rot similar to that caused by *Diplodia natalensis*. The pycnidia are readily produced on the lemon fruits when old and also on potato-dextrose-agar after some weeks. The cultural characteristics are similar to *Diplodia natalensis*.

The fungus has not yet proved to be of any great importance in Queensland forestry practice.

Reactions of Hoop Pine (Araucaria Cunninghamii) to Diplodia Pinus, D. Natalensis, and Botrodiplodia theobromæ.

Owing to the importance of hoop pine as a timber tree in softwood plantations in Queensland it was thought that the susceptibility of this species to the three fungi under discussion should be tested. In the case of *D. pinea* and *D. natalensis* inoculations of hoop pine seedlings were carried out at the same time and in the same manner as were the *Pinus* inoculations. Six trees were inoculated with each fungus, and in all cases the trees proved to be unsusceptible to attack by these pathogens. Small seedlings of hoop pine, 2 inches high, were inoculated with a culture of *Botryodiplodia theobromæ*, the seeds being planted in seed-boxes and the plants inoculated in situ. In this instance, the plants were killed by the fungus, the injury taking the form of damping off.



Plate 138.

Microphotograph showing spores of *Diplodia natalensis*, K3 filter, exposure 5 seconds. x 400.

Summary.

A brief historical account of the occurrence of *Diplodia* dieback in Queensland forestry areas is given and the two species of *Diplodia* noted in association with the trouble. The species are identified as *Diplodia pinea* Desm. Kickx. and *Diplodia natalensis* Pole-Evans.

The pathogenicity of these fungi is established by inoculation studies, and both are determined as being causes of dieback.

The appearance of the disease as caused by each of the pathogens is described, and a list of the species attacked by each fungus is given.

The fungi are discussed individually, and a description of each of the two species, noting their morphological and cultural characteristics, together with their temperature relationships, is given. The weather conditions prevailing at the time of heavy attacks are included.

Insect associations with dieback caused by *D. pinea* are discussed in relation to *Chermes* sp.

The association of dieback of *Pinus tæda* and *P. caribæa* with diseased citrus trees is noted and reasons for concluding that the citrus trees were acting as a source of infection advanced.

The control measures adopted are outlined for both species.

A summary of the differences between the two diseases is given.

The occurrence of *Botryodiplodia theobromæ* on hoop pine seed and seedlings is noted as causing a rot of the former and death of the latter. Inoculations of lemon fruits with the fungus are described, and its characteristics, cultural and otherwise, are briefly noted.

The reactions of hoop pine (*Araucaria cunninghamii*), an important forest tree in Queensland, to inoculations with *Diplodia pinea, D. natalensis,* and *Botryodiplodia theobromæ,* are noted.

Thanks are due to Mr. I. W. Helmsing for the co-operation received in the preparation of the microphotographs.

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Studies on the Biology and Control of the Large Roundworm of Fowls, Ascaridia galli (Schrank 1788) Freeborn 1923.

F. H. S. ROBERTS, D.Sc., Animal Health Station, Yeerongpilly.

[*Continued from p.* 191, *August*, 1936.]

PART III.

4. THE PATHOGENICITY OF INFESTATION WITH ASCARIDIA GALLI.

I. Previous Investigations.

OUR present knowledge of the pathogenicity of *A. galli* is due largely to controlled studies by Herrick and Ackert. Herrick[63] reported that the first visible effects of an infestation in chicks one month old are denoted by loss of appetite accompanied by drooping wings, ruffled feathers, weakness and decreased activity. Death may occur as early as the ninth or tenth day. Significant differences in gains in weight were observed between infested and control chicks, especially during the first two weeks. Infested chicks may eventually throw off most of their worms and recover to a great extent, if not entirely.

Guberlet[58] found that a single dose of 750 eggs to chicks one month old may have serious effects, causing droopiness and death on the ninth to tenth day. Heavy infestations were noted to be fatal as early as the eighth day. These effects were considered by Guberlet to be due to intestinal irritation and a toxæmia.

Ackert,[7] summarising the results of his investigations, showed that chicks two to seven weeks old to which doses of 1,000 to 2,000 eggs had been given may lose their appetite within ten days. By the twelfth day the birds may be visibly affected, with a depressed, humped-up appearance, ruffled feathers, and drooping wings. The invasion of the intestinal wall by the larvæ causes conspicuous hæmorrhages, and the larvæ destroy the intestinal glands. From the twelfth to the seventeenth day there is little gain in weight by infested birds, and many birds may lose weight. During this period mortalities may be serious. The appetite of the birds that survive may thereafter be voracious, and recovery may be rapid. As a result of infestation, the thymus gland is greatly reduced in size, and the blood may lose a significant portion of its sugar. There is marked retardation of muscular and osteological development, accompanied by excessive deposition of urates in the ureters. These effects are considered by Ackert to be due to injury to the intestinal wall by the larvæ, to loss of blood from intestinal hæmorrhage, to bacterial infection, to partial starvation through loss of appetite, and to the absorption of metabolic wastes.

Itagaki[67] reported that in Tokyo, Japan, the larvæ cause the formation of nodules in the intestinal wall, but makes no other comment upon the pathogenicity of Ascaridia.

Baker[26] had noted that in experimentally produced cases of ascaridiasis, there is a marked distension of the blood vessels of the parenchymatous organs and a noticeable enlargement of the heart. He has also observed that in chickens that survive the acute stages of infestation there is an increased tendency to the formation of neoplasms.

As regards the effect of the adult worms upon the host, various workers have drawn attention to the emaciation and anæmia which may accompany an infestation. Intestinal impaction has been frequently reported, associated in some cases with a rupture of the intestinal wall.

Ackert[1] has recorded an observation regarding the number of worms chickens may tolerate, and notes that thirty or more worms may visibly affect, and in some cases be fatal to grown birds. Von Mocsy[76], from observations on poultry farms in Germany, reported that as few as four to five adult worms may be fatal to young chickens, and fifteen to twenty worms to young hens.

It is generally conceded that this roundworm may also have a marked effect upon egg production, though, as far as the writer can determine, there is no experimental evidence which confirms this view. Ackert and Herrick[6] found that chickens given several doses of eggs, sufficiently great to produce marked symptoms of infestation, may eventually recover and that no effects of the infestation on egg production may be visible several months later, when the birds become mature.

Other observations on the effect of *A. galli* upon egg production have been made by comparing production before and after the employment of an anthelmintic. These trials have been carried out under field conditions, and the birds have been infested with other helminths as well as *A. galli*. The information secured by these means has been very difficult to interpret, as it has been shown that an anthelmintic itself may have a depressing action upon producing birds, and that such birds may become reinfested shortly after treatment. In some treatment trials carried out by Thomas,[100] however, there were indications that there may be little correlation between the degree of infestation and egg production, as three of the best layers in the flock under observation passed seventy-seven, sixty-four, and thirty-seven worms, respectively, after treatment.

Much has been written regarding the association of leg paralysis with *A. galli* infestation, and in one case reported by Rover (Cram[43]) the paresis completely cleared up when this roundworm was removed by treatment. This type of leg paralysis, which is due to extreme leg weakness, is not to be confused with neurolymphomatosis gallinarum, which disease is now considered to be unassociated with parasite infestation, though in some quarters the opinion is held that the presence of *A. galli* and other helminths may assist in the production of the disease.

II. Observations Recorded in these Investigations.

In the following experiments the pathogenicity of *A. galli* was studied under conditions involving—

(i.) A single dose of varying numbers of infectious eggs.

(ii.) Continuous infestation, in which chickens were fed a number of eggs per day.

(i.) Observations from Experiments in which a Single Dose of Eggs was Employed.

(*a*) *Birds Employed for Life Cycle Studies.*

The observations recorded here were made on chickens given single doses of 50 to 2,000 eggs at thirty days old, and on three further birds given 10,000 to 15,000 eggs at forty-three days old. (See Table VII.)

Doses of 50 *and* 100 *Eggs.*—No visible symptoms were manifested by any of the chickens to which these doses of eggs had been administered.

Dose of 500 *Eggs.*—The five birds given this dose of eggs remained bright and normal up to the period of autopsy, except that the combs became pale in colour and there was slight evidence of intestinal hæmorrhage during the third week after infestation.

Dose of 1,000 *Eggs.*—Chickens Nos. 10, 12, 14, and 16 were each fed 1,000 eggs and autopsied after twelve, thirteen, fifteen, and seventeen days, respectively. With the exception of No. 16, all birds showed some evidence of infestation. From about the twelfth to sixteenth day the fæces was diarrheal in consistency and streaked with blood. The birds were depressed and not very active, with decreased appetite. No. 14 was most affected, and at the time of autopsy was humped up in appearance, with ruffled feathers and drooping wings. In all four birds the combs were pale.

Dose of 2,000 *eggs.*—The three birds given 2,000 eggs and examined within three days of infestation (Nos. 2, 3, and 4) were not affected to any noticeable degree. When the period of infestation was extended to six and ten days, especially with the longer period, however, the infested birds showed diarrhœa, decreased activity, and an impaired appetite.

Doses of 10,000 *to* 15,000 *Eggs.*—Three chickens forty-three days old were given a single dose of 10,000, 10,000, and 15,000 eggs, respectively. As early as three days after infestation these birds were considerably depressed, humped-up, with ruffled feathers, drooping wings, pale combs and legs, inactive, and with a conspicuously impaired appetite and abnormal thirst. The next few days were marked by a rapidly increasing weakness and diarrhœa, the birds remaining squatting or lying, and showing a disinclination to move when disturbed. By about the eleventh day all birds had become extremely emaciated, and were voiding blood-streaked fæces. Birds Nos. 11 and 13, fed 10,000 and 15,000 eggs, respectively, died on the twelfth and thirteenth day, but No. 15, given 10,000 eggs, was still alive on the sixteenth day when it was autopsied.

(*b*) *Group Studies.*

These experiments were undertaken in order to check up the observations regarding pathogenicity made during the life cycle studies, and also to ascertain, if possible, the pathogenic effects of the various stages in the life cycle by allowing the infestation to extend over a longer period.

In the first series of experiments three groups of chickens thirty days old, each of five birds, were given a single dose of 100, 500, and 1,000 eggs, respectively. When planning the experiment it was found that a suitable uninfested control group could be secured for Group III. only (1,000 eggs). It was therefore decided to select all birds of even weight for Group I. (100 eggs) and Group II. (500 eggs), so that each of these two groups, by being equal not only in the initial mean weights, but also in the weight of each individual bird, could act as controls one to the other. Throughout, all groups were weighed weekly, and, as accommodation was not available for individual birds, they were housed in the respective groups of five.

Group I.—This group was fed a single dose of 100 *eggs at thirty days old.*

Symptoms as might be associated with the feeding of this number of eggs were observed in this group only towards the latter part of the sixty-three-day period that the birds were kept under observation. Commencing from about the fifth week there was, in general, particularly in chickens Nos. 38 and 40, a distinct loss of colour in the combs and legs and of brightness in the plumage.

GRAPH No. 1.

(A)—Actual Mean Weekly Body Weights.

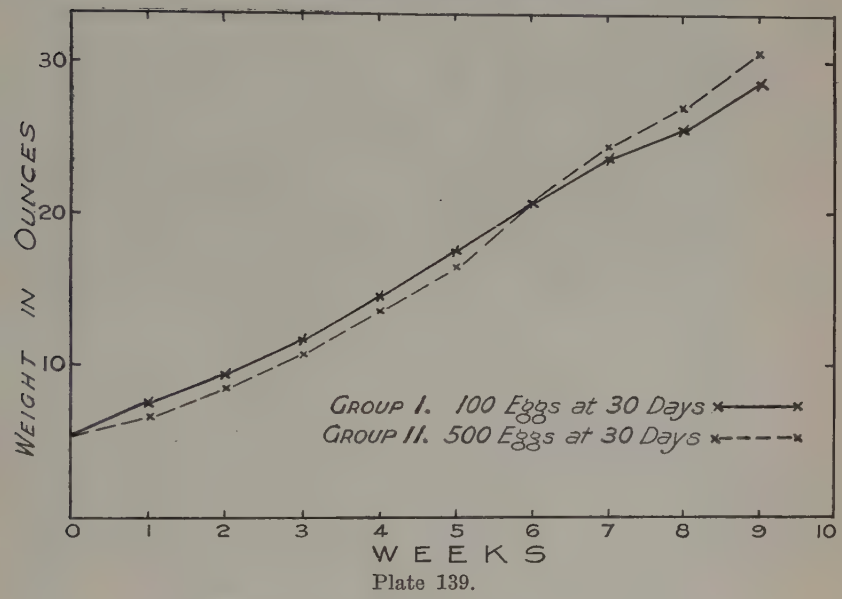


Plate 139.

(B)—Differences between Mean Weekly Gains in Weight of Groups I. and II.

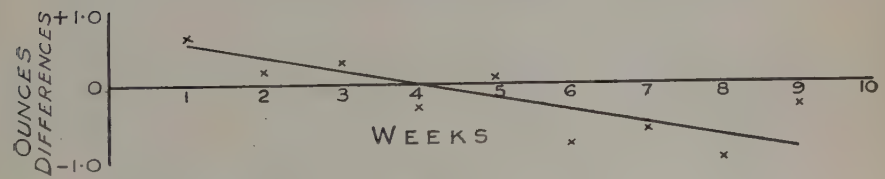


Plate 140.

$y = 0{\cdot}6 - 0{\cdot}16x$.

$y = 0$ when $x = 3{\cdot}7$.

b significant.

(i.e.) downward slope.

Group II.—This group was fed a single dose of 500 *eggs at thirty days old.*

The effects of this infestation were first observed towards the end of the second week. At this time and during the third week the combs were pale, the plumage somewhat dull, and the droppings gave evidence of a slight degree of intestinal hæmorrhage. Thereafter all birds recovered to a great extent, but towards the sixth week Nos. 43 and 45 again became slightly unthrifty in appearance. As with Group I., the period of infestation was sixty-three days.

TABLE VIII.

GROUP I.

No. of Bird.	Weight in Ounces.										No. Worms at Autopsy.
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.	9th. Week.	
38	5·25	7·5	9·5	11·5	16	19·5	21	22	23	23·5	36
39	5·25	7	8·5	11	14·5	15·5	19·5	22·5	24	28·5	5
40	5·25	6·5	8	11	13·5	16	18·5	21·5	23	25·5	32
41	5·25	7·5	10·5	12·5	15	16·5	22	25·5	28·5	32·5	15
42	5·25	7·5	9·5	12·5	14	18·5	23	26·5	29	34	24

GROUP II.

No. of Bird.	Weight in Ounces.										No. Worms at Autopsy.
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.	9th. Week.	
43	5·25	6	7·5	9·5	12·5	15	18·5	20·5	23·5	26	34
44	5·25	6·5	8	10·5	13	15·5	19·5	24	27·5	33	..
45	5·25	6·5	9	12	15·5	17·5	19	21·5	23·5	25·5	29
46	5·25	7	8·5	10	12	15·5	23·5	27·5	30·5	34	17
47	5·25	7	9	11	16	18	23	27	30	34·5	11

In Table VIII. are set out the weekly weights in ounces of each bird in each group, together with their analyses and the number of worms occurring in each bird on autopsy.

TABLE VIII.—*continued.*
ANALYSIS OF GROUPS I. AND II.

	Weight in Ounces.				
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.
Mean weekly weights, Group I.	5·25	7·2	9·2	11·7	14·6
Mean weekly weights, Group II.	5·25	6·6	8·4	10·6	13·8
Mean gain in weight per week, Group I.	..	1·90 ± 0·20	2·00 ± 0·27	2·50 ± 0·22	2·90 ± 0·51
Mean gain in weight per week, Group II.	..	1·30 ± 0·19	1·80 ± 0·20	2·20 ± 0·26	3·20 ± 1·02
Differences between mean gains per week of Groups I. and II. ..	..	+0·60	+ 0·20	+ 0·30	− 0·30
Significance of difference	..	N.S.	N.S.	N.S.	N.S.

	Weight in Ounces.				
	5th. Week.	6th. Week.	7th. Week.	8th. Week.	9th. Week.
Mean weekly weights, Group I.	17·2	20·8	23·6	25·5	28·8
Mean weekly weights, Group II.	16·3	20·7	24·1	27	30·6
Mean gain in weight per week, Group I.	2·60 ± 0·64	3·60 ± 0·72	2·80 ± 0·47	1·90 ± 0·37	3·30 ± 0·82
Mean gain in weight per week, Group II.	2·50 ± 0·28	4·40 ± 1·07	3·40 ± 0·49	2·90 ± 0·25	3·60 ± 0·75
Differences between mean gains per week of Groups I. and II. ..	+ 0·10	− 0·80	− 0·60	− 1·00	− 0·30
Significance of difference	N.S.	N.S.	N.S.	N.S.	N.S.

Throughout these tables—N.S. = non significant ($P > \cdot05$). A.S. = approaching significance ($\cdot01 < P < \cdot05$). S. = significant ($P < \cdot01$).

A preliminary interpretation of these weights was made by comparing the actual mean weekly body weights of each group (Graph No. 1 (A). The plotted points show that during the first few weeks after infestation the heavier infestation (500 eggs) was apparently responsible for the smaller mean weekly weights of Group II. The differences between the mean weekly weights of the two groups showed thereafter a gradual decrease, until at about the end of the sixth week the difference approached zero, and thereafter favoured Group II.

An analysis of the mean weekly gains in weight of the two groups shows that up till the end of the third week the group given 100 eggs gained more than the group given 500 eggs, but thereafter, except for the difference at the end of the fifth week, the mean weekly gains were greater in the group given the greater number of eggs.

When the differences between the amounts of mean weekly gain in weight of the two groups are plotted (Graph No. 1 (B)), the points are best fitted by a straight line which crosses the axis and has a downward trend which is statistically significant. This line crosses the axis during the fourth week after infestation. That is, at this point Group II. overtook Group I. in amount of mean weekly gain, and thereafter its gains were greater. As Group I. contained more worms than Group II. at autopsy (see Table VIII.), it would appear that from this point the heavier infestation of Group I. was responsible for influencing this group's weekly gains to this extent. It is interesting to note that at the point where Group II. overtook Group I. in amount of weekly gain, that is, during the fourth week after infestation, the worms were approaching maturity.

It may therefore be considered that for the first four weeks after infestation a single dose of 500 eggs is more pathogenic than a single dose of 100 eggs. Thereafter the effects are correlated with the number of well-grown worms surviving, being more conspicuous in the case of the heavier infestation.

GRAPH No. 2.

(A)—ACTUAL MEAN WEEKLY BODY WEIGHTS.

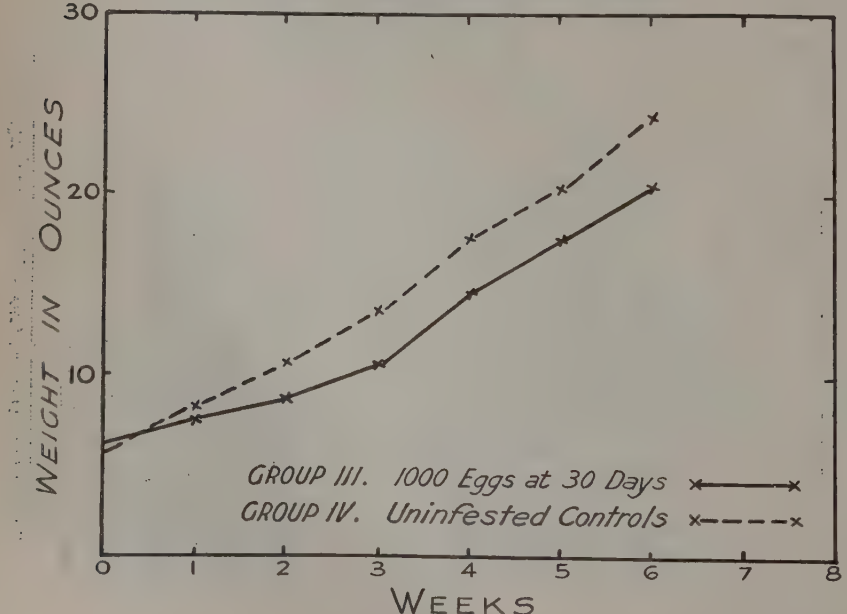


Plate 141.

(B)—Differences between Mean Weekly Gains in Weight of Groups III. and IV.

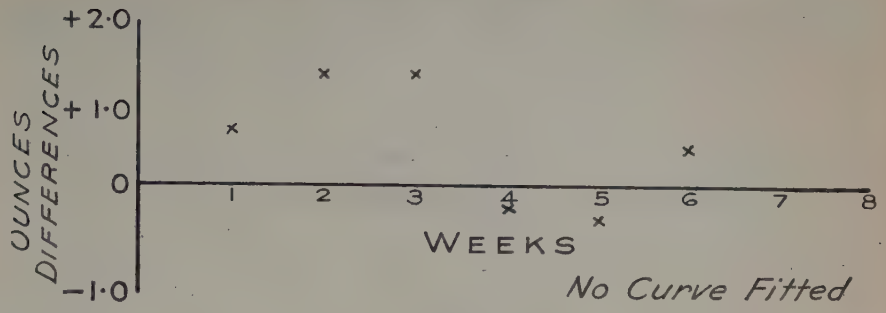


Plate 142.

Group III.—This group was fed a single dose of 1,000 *eggs at thirty days old.*

At the end of the first week all birds were somewhat depressed, and in some of the birds the droppings were diarrheal in consistency. From the twelfth to the seventeenth day the droppings were tinged with blood and the birds showed loss of appetite and activity, with pale combs and dull plumage. Chicken No. 50 was most affected, with drooping wings and ruffled feathers. By the end of the fourth week all birds had recovered to a great extent, and except for pale combs and dull plumage showed no other evidence of infestation.

The weekly weights of this group and of the uninfested control group, Group IV., are compared in Table IX., in which is also given the number of worms found at autopsy in each bird of Group III.

A consideration of the actual mean weekly body weights of Group III., and of its control, Group IV. (Graph No. 2 (A)) shows that up till the end of the third week the mean weekly weights of the uninfested group gradually drew away from those of the infested group. After the third week, however, the graph indicates that the infested birds recovered to some extent, so that thereafter the plotted points for the two groups follow a somewhat parallel course, the mean weekly weights of the control group being always the greater.

An analysis of the differences between the mean gains in weight per week of each group shows that up till the end of the third week the gains were greater in the controls. Then followed a short period of two weeks in which the infested birds gained in weight to the greater extent. The fact that the amount of gain during the sixth week again favoured the controls may possibly be due to the number of well-grown worms in the infested group adversely influencing its gain.

When these differences in amount of mean weekly gain of the two groups were plotted no mathematical curve could be fitted to the data supplied, as no definite turning point or point of zero difference could be determined (Graph No. 2 (B)). The fact that one difference is statistically significant, namely, 1·40 oz. at the third weighing, shows, however, that the fall of the graph to below zero has a definite downward trend.

TABLE IX.

GROUP III.

No. of Bird.	Weight in Ounces.							No. Worms at Autopsy.
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	
48	6·75	8·5	9	11	15	18·5	22·5	14
49	6·25	8·5	9·5	11·5	16	20·5	25	31
50	6	7·5	9	11·5	16·5	18	20·5	26
51	5·75	6·5	7·5	9·5	11·5	14	16·5	43
52	5·75	7	9·5	10	14	17·5	22	5

GROUP IV. (CONTROLS).

No. of Bird.	Weight in Ounces.							No. Worms at Autopsy.
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	
53	6·5	7	9	12·5	16·5	18·5	22·5	..
54	6	8·5	13	16	20·5	24·5	28	..
55	6	8·5	11·5	14·5	18	20	25	..
56	5·5	8	9·5	13	16·5	20	24·5	..
57	5·5	8	10·5	13·5	16·5	18·5	21·5	..

ANALYSIS OF GROUPS III. AND IV.

	Weight in Ounces.						
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.
Mean weekly weights, Group III.	6·1	7·6	8·9	10·7	14·6	17·7	21·3
Mean weekly weights, Group IV.	5·9	8	10·7	13·9	17·6	20·3	24·3
Mean gain in weight per week, Group III.	..	$1·50 \pm 0·25$	$1·30 \pm 0·39$	$1·80 \pm 0·39$	$3·90 \pm 0·51$	$3·10 \pm 0·51$	$3·60 \pm 0·46$
Mean gain in weight per week, Group IV.	..	$2·10 \pm 0·40$	$2·70 \pm 0·52$	$3·20 \pm 0·12$	$3·70 \pm 0·26$	$2·70 \pm 0·44$	$4·00 \pm 0·36$
Differences between mean gains per week of Groups III. and IV.	..	$+ 0·60$	$+ 1·40$	$+ 1·40$	$- 0·20$	$- 0·40$	$+ 0·40$
Significance of difference	..	N.S.	N.S.	S.	N.S.	N.S.	N.S.

The interpretation given this analysis indicates that the birds in Group III. were affected during the first three weeks. Thereafter followed a period of recovery, but the upward trend of the graph during the sixth week shows that Group III. were once more affected, probably on this occasion by the infestation of well-grown worms.

GRAPH No. 3.

(A)—Actual Mean Weekly Body Weights.

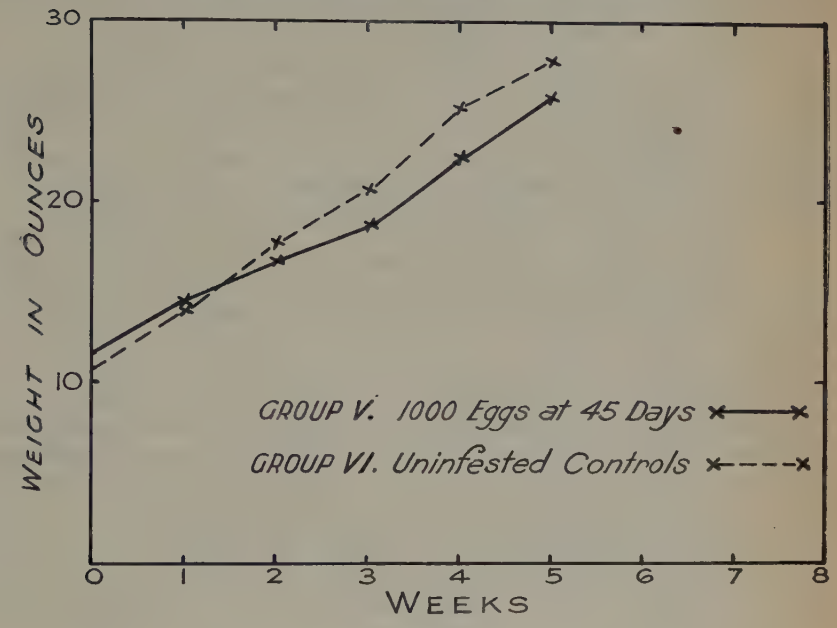


Plate 143.

(B)—Differences between Mean Weekly Gains in Weight of Groups V. and VI.

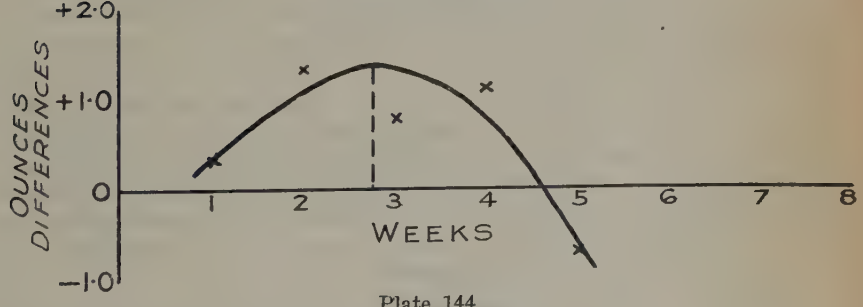


Plate 144.

$y = -1{\cdot}38 + 2{\cdot}02 \times -0{\cdot}37\,x^2$.

Turning-point when $x = 2{\cdot}7$.

$y = 0$ when $x = 4{\cdot}6$.

b and c approaching significance.

(i.e.) both upward and downward trends.

Group V.—This group was fed a single dose of 1,000 *eggs at forty-five days old.*

The final experiment in this series was to determine the effect of a single dose of 1,000 eggs upon chickens forty-five days old.

The symptoms exhibited by this group and their sequence did not differ to any marked extent from those exhibited by Group III., though in general they were not so marked. The weekly weights of Group V. and those of its control group, Group VI., together with the number of worms present at autopsy in Group V. are given in Table X.

The mean weekly body weights of the infested and control groups are compared in Graph No. 3 (A). It will be noticed that although the mean initial weight of Group V. was the greater, the effect of the infestation was such that the mean body weight of the control group became the heavier during the second week, the plotted points for the two groups after the third week following a somewhat parallel course.

An analysis of the mean weekly gains in weight of each group shows that the control birds gained in weight to the greater extent during the first four weeks, the difference in gain during the second week being significant. During the fifth week, however, the gain in weight favoured the infested group. When these differences in gains were plotted a mathematical curve was found to fit the data supplied (Graph No. 3 (B)). This fitted curve shows that the weekly gains by the controls drew significantly away from those of the infested birds until the third week, after which the differences decreased significantly to zero during the fifth week, that is, at this point the curve crossed the axis.

Thus, it appears that during the first three weeks after infestation Group V. was significantly affected by the dosage of eggs employed. The downward trend of the curve from about this point indicates that the infested birds were recovering, until at the fifth weighing their amount of weekly gain exceeded that of the controls.

Discussion.

The data secured from the above experiments in which a single dose of varying numbers of eggs of *A. galli* was fed to young birds is considered to yield the following information regarding the pathogenicity of this roundworm.

1. Symptoms of infestation may be displayed by young birds following the administration of a single dose of eggs varying from 100 to 15,000 in number. With a dosage of 15,000 eggs young birds may be markedly affected within three days after infestation, whereas a single dose of 100 eggs may not produce any pathogenic effects until the worms have been present for about five weeks or more. In all cases examined the infestation affected normal growth.

2. From a study of the effects of a single dose infestation upon body weight, as interpreted by an analysis of the amounts of mean weekly gain in weight of infested and control birds, and correlated with the manifestations of clinical symptoms of infestation, the effects of an infestation may, it is considered, be divided into three distinct stages:—

TABLE X.

Group V.

No. of Bird.	Weight in Ounces.						No. Worms at Autopsy.
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	
58	13·5	17	19	21·5	24·5	28	..
59	11·5	14·5	16·5	19	22·5	26·5	20
60	11	13	16	18·5	20	21·5	94
61	11	14·5	17·5	18·5	22	26·5	14
62	10·5	13	15·5	17	21·5	26	24

Group VI. (Controls).

No. of Bird.	Weight in Ounces.						No. Worms at Autopsy.
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	
56	9·5	13	16·5	20	24·5	28	..
63	11·5	14·5	18	20·5	25	27	..
55	11·5	14·5	18	20	25	27·5	..
64	13	16	20·5	24·5	28	31·5	..
65	9	12·5	16·5	18·5	22·5	25·5	..

Analysis of Groups V. and VI.

	Weight in Ounces.					
	At Infestation.	1st. Week.	2nd Week.	3rd Week.	4th Week.	5th Week.
Mean weekly weights ,Group V.	11·5	14·4	16·9	18·9	22·1	25·7
Mean weekly weights, Group VI.	10·9	14·1	17·9	20·7	25	27·9
Mean gain in weight per week, Group V. ..	..	2·90 ± 0·29	2·50 ± 0·23	2·00 ± 0·32	3·20 ± 0·50	3·60 ± 0·56
Mean gain in weight per week, Group VI. ..	..	3·20 ± 0·12	3·80 ± 0·20	2·80 ± 0·42	4·30 ± 0·28	2·90 ± 0·29
Differences between mean gains in weight per week, Groups V. and VI.	..	+ 0·30	+ 1·30	+ 0·80	+ 1·10	−0·70
Significance of difference	..	N.S.	S.	N.S.	N.S.	N.S.

(*a*) During the first three weeks after infestation the pathogenic effects may be very marked. These effects may be in evidence during the first week, but become more pronounced during the second and third weeks. During this three-weekly period there may be a significant difference between the amount of gain by infested and control birds. A consideration of the life history shows that the pathogenicity of A. *galli* during the first week after infestation must be due solely to the presence of the larvæ, and that the more marked effects during the second and third weeks are associated with the period when the larvæ attack the intestinal tissues (tenth to nineteenth day).

(*b*) Following the return of the larvæ to the lumen of the intestine, and providing the infestation is not too severe, there is a short period of recovery when infested birds may gain in weight to a greater extent than uninfested controls.

(*c*) Finally, there is a period which in young birds may commence as early as the fourth week, when the surviving larvæ, by this time mature, or almost so, and if sufficiently numerous, may be responsible for a further adverse effect upon body weight, infested birds during this period again failing to equal the gains in weight by the controls.

Throughout this investigation an attempt was made to ascertain the number of adult worms which could be tolerated by young and grown birds. In so far as the above experiments are concerned it is unfortunate that the periods of infestation were not of sufficient duration to yield any accurate information on this point. Such information would have been extremely valuable in so far as it would have been secured under controlled conditions. An attempt to secure some information by considering a regression of the gains in weight by the individual birds from the fourth week, that is, from about the period when the worms were approaching maturity, to the end of the respective trials, on the number of worms present, indicated that in young birds two to three months old twenty-five or more worms may affect growth. From the graphs secured it also appeared that in some cases smaller numbers of worms than this may possibly stimulate growth.

An interpretation of the results given by an examination of some hundreds of young and old naturally infested birds was even more difficult, as in these naturally infested cases it was practically impossible to eliminate other factors which may have contributed to the abnormal appearance of the birds under consideration. Two-months-old birds have been seen with worm burdens of twenty to thirty worms without any marked effects of the infestation, and, on the other hand, this number of worms appeared responsible for emaciation and anæmia in birds as old as six months. It may be said, however, that in young birds two to four months old about twenty to thirty worms, and at six months of age thirty to forty worms, respectively, may be harmful.

In laying hens on an adequate diet fifty or more worms may be harmful. The number of worms adult birds can tolerate without manifesting any conspicuous evidence of infestation is, however, in some

cases, astounding. Worm burdens of up to 150 large and many small worms have been observed in individual birds without the body weight or the appearance of the bird being affected to any marked degree.

Further discussion on the effect of *A. galli* on adult birds will be found in the section, "Control of *Ascaridia galli*."

(ii.) Observations from Experiments in which Continuous Doses of Eggs were Employed.

This series of experiments was undertaken in order to determine the effects of infestation under conditions involving the continuous administration of eggs, thereby approaching the conditions of hyper-infestation existent in the field.

Three groups, each of five birds, were employed, and each group was given a number of eggs per day, commencing at the ages of thirty days, fifty-eight days, and seventy-nine days, respectively. Each of these three groups was controlled by an uninfested group of five birds of similar age.

As in the experiments in which a single dose of eggs was administered, the weights of all birds were taken weekly, and in the following tables are expressed in ounces.

GRAPH No. 4.

(A)—Actual Mean Weekly Body Weights.

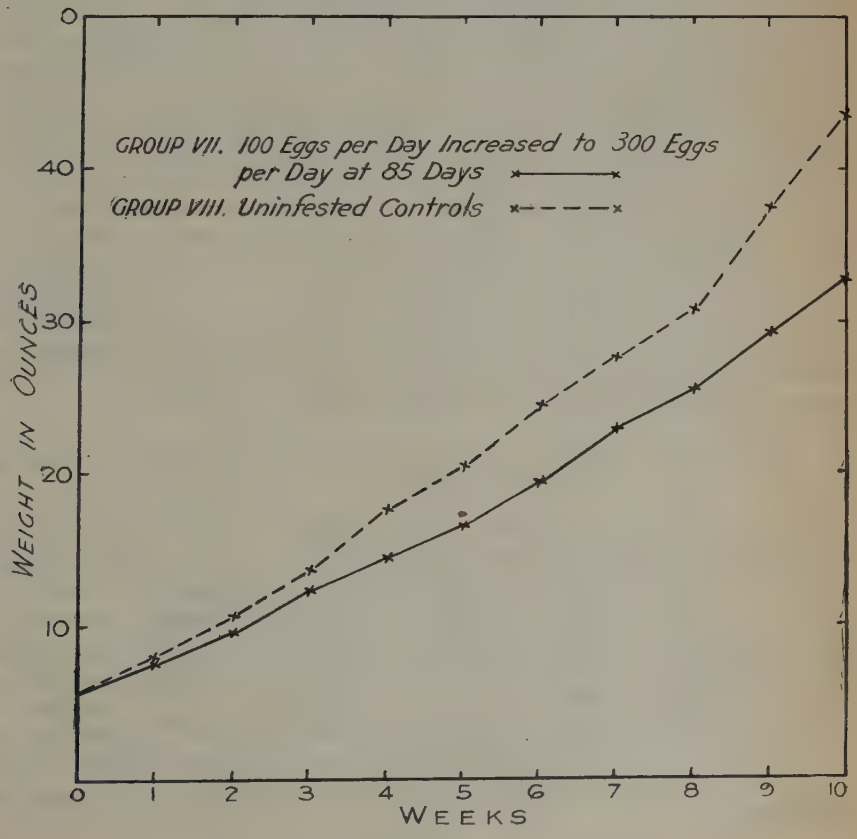


Plate 145.

(B)—DIFFERENCES BETWEEN MEAN WEEKLY GAINS IN WEIGHT OF GROUPS VII. AND VIII.

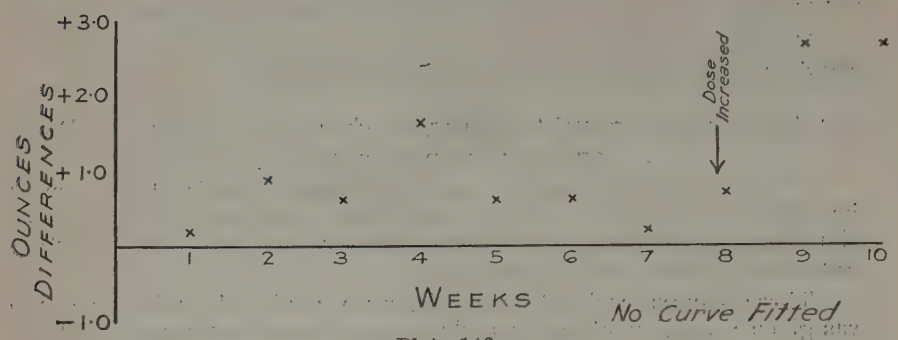


Plate 146.

Group VII.—This group was given 100 *eggs per day from the age of thirty days, the dose being increased to* 300 *eggs per day from the age of eighty-five days.*

Sixteen days after the administration of the first dose of eggs the droppings were diarrheal in consistency, and showed evidence of intestinal hæmorrhage. By the twenty-second day all birds were depressed to varying degrees, and the droppings were conspicuously streaked with blood. Chickens Nos. 67 and 69 were least affected, and from this point recovered fairly rapidly, to remain bright and normal for the remaining period of the trial. In the case of the other three birds the presence of blood in the fæces continued intermittently for another three weeks. By the end of the first month these three birds were unthrifty in appearance, No. 68 being most affected. At the end of six weeks Nos. 66 and 70 appeared to have recovered to a great extent, but were small and stunted in appearance. No. 68, however, continued to be markedly affected, and towards the end of the seventh week commenced to show evidence of advanced weakness. After the increase in the number of eggs to 300 per day on the fifty-fifth day, Nos. 66 and 70 were again noticeably affected, whilst No. 68 ultimately became so weak it could no longer stand, but remained lying on its side. This experiment was terminated at the end of the tenth week.

The weekly weights of these birds and those of the controls (Group VIII.) are compared in Table XI.

The actual mean weekly body weights of the infested birds, Group VII., and the controls, Group VIII. are compared in Graph No. 4 (A). This graph shows that from the commencement of the trial the mean weekly weights of the control group became increasingly greater throughout the course of the trial than those of the uninfested group, so that the plotted points representing the respective weights follow a divergent course. It will be observed that the increase in dosage to 300 eggs per day on the fifty-fifth day was responsible for a more disproportionate difference in the mean weekly weights of the two groups at the ninth and tenth week than was present at any previous weighing.

TABLE XI.

Group VII.

No. of Bird.	Weight in Ounces.										
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.	9th. Week.	10th. Week.
66	6	6·5	8·5	13	14·5	15·5	20	23	23	25·5	28·5
67	6·75	8·5	10·5	13·5	16·5	20·5	23	26·5	30	35·5	42·5
68	5·75	7·5	8	9	10·5	11·5	13·5	18	21·5	22	21
69	5·75	9	11	14·5	17	20·5	26	30	32·5	39	45
70	5·25	7·5	10	11	13	14	16·5	17·5	20	23·5	26·5

Group VIII. (Controls).

No. of Bird.	Weight in Ounces.										
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.	9th. Week.	10th. Week.
65	6·5	7	9	12·5	16·5	18·5	22·5	25·5	28·5	33·5	40
64	6	8·5	13	16	20·5	24·5	28	31·5	36	42·5	50·5
55	6	8·5	11·5	14·5	18	20	25	27·5	30	37	42
56	5·5	8	9·5	13	16·5	20	24·5	28	31	37·5	43·5
71	5·5	8	10·5	13·5	16·5	18·5	21·5	26	28·5	35	41

TABLE XI—*continued.*
ANALYSIS OF GROUPS VII AND VIII.

	Weight in Ounces.					
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.
Mean weekly body weights, Group VII.	5·9	7·8	9·6	12·2	14·3	16·4
Mean weekly weights, Group VIII.	5·9	8	10·7	13·9	17·6	20·3
Mean gain per week, Group VII.	..	1·90 ± 0·45	1·80 ± 0·34	2·60 ± 0·70	2·10 ± 0·29	2·10 ± 0·68
Mean gain per week, Group VIII.	..	2·10 ± 0·40	2·70 ± 0·52	3·20 ± 0·12	3·70 ± 0·26	2·70 ± 0·44
Differences between mean gains per week of Groups VII. and VIII.	..	+ 0·20	+ 0·90	+ 0·60	+ 1·60	+ 0·60
Significance of difference	..	N.S.	N.S.	N.S.	S.	N.S.

	Weight in Ounces.				
	6th. Week.	7th. Week.	8th. Week.	9th. Week.	10th Week.
Mean weekly body weights, Group VII.	19·8	23	25·4	29·1	32·8
Mean weekly weights, Group VIII.	24·3	27·7	30·8	37·1	43·4
Mean gain per week, Group VII.	3·40 ± 0·68	3·20 ± 0·61	2·40 ± 0·64	3·70 ± 0·96	3·70 ± 0·92
Mean gain per week, Group VIII.	4·00 ± 0·36	3·40 ± 0·33	3·10 ± 0·37	6·30 ± 0·34	6·30 ± 0·49
Differences between mean gains per week of Groups VII. and VIII.	+ 0·60	+ 0·20	+ 0·70	+ 2·60	+ 2·60
Significance of difference	N.S.	N.S.	N.S.	A.S.	A.S.

An analysis of the differences between the mean weekly gains in weight of the two groups shows that throughout the whole period of the experiment the gain was always greater in the control group, a significant difference occurring at the fourth weighing. Following the increase in the number of eggs per day to 300, the differences in gain during the ninth and tenth weeks were sufficiently great to be regarded as approaching significance. Over the whole period of the experiment the infested birds gained an average of 26·90 ± 4·02 oz., and the controls an average of 37.50 ± 1.87 oz., the difference, namely 10.60 oz., approaching significance.

No mathematical curve could be found which fitted the points representing the differences in amount of mean weekly gain between the two groups (Graph No. 4 (B)). Up to the time of the increase in dose there is a general upward and downward trend, indicating possibly that the infested birds were at first affected and then recovered to some extent. After the seventh week the curve again rises, showing that the birds were again affected, this time, possibly, by the increase in the daily dose on the fifty-fifth day. The general trend of the curve, however, cannot be accurately analysed, as no negative differences were recorded.

GRAPH No. 5.
(A)—Actual Mean Weekly Body Weights.

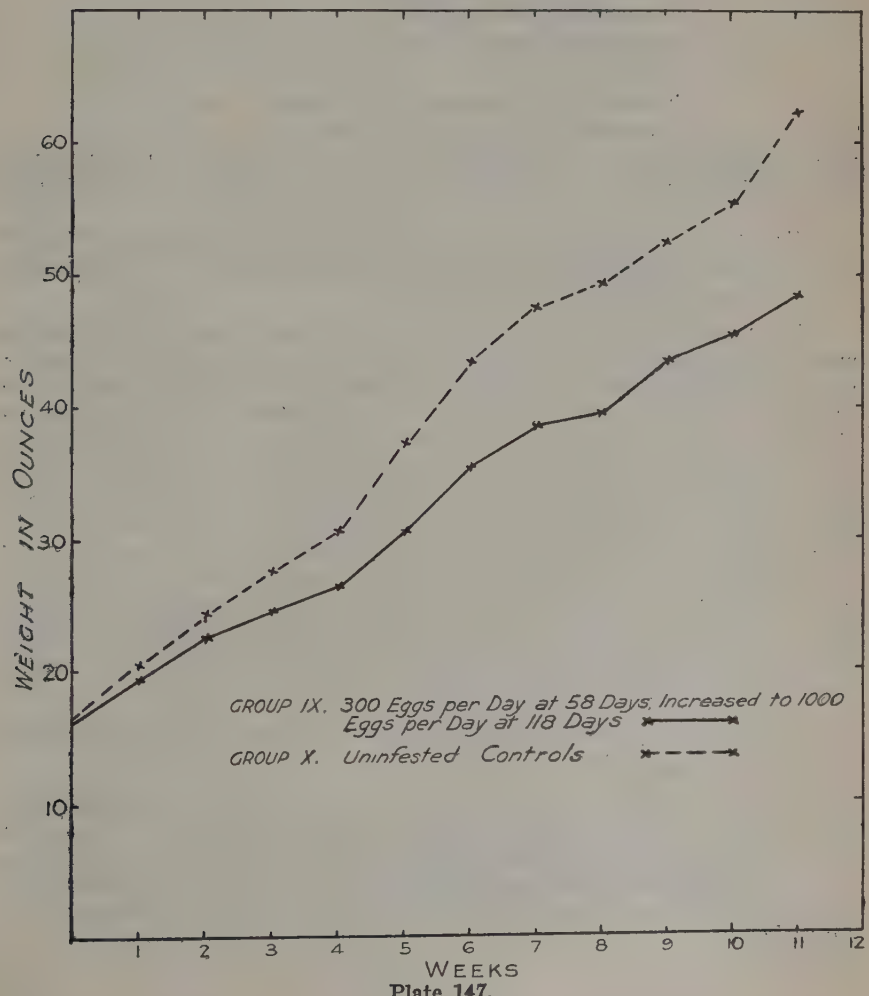


Plate 147.

(B)—DIFFERENCES BETWEEN MEAN WEEKLY GAINS IN WEIGHT OF GROUPS IX. AND X.

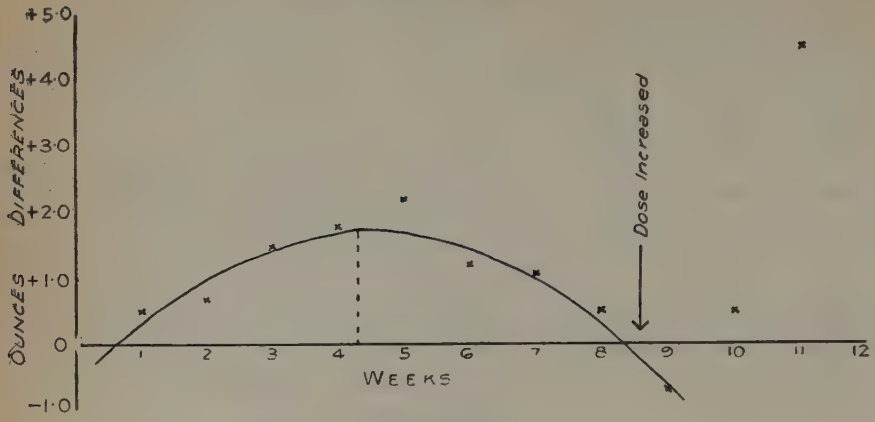


Plate 148.

$y = -0{\cdot}66 + 1{\cdot}09 \times -0{\cdot}12\ x^2$.

Turning-point when $x = 4{\cdot}2$.

$y = 0$ when $x = 8{\cdot}3$.

b approaching significance (i.e.) upward trend.

c significant (i.e.) downward trend.

NOTE.—In Groups IX.-X. the weighing just after the increase in dose showed no great disturbance from the previous trend and was included in the fitted curve.

Group IX.—This group was given 300 *eggs per day from the age of fifty-eight days, the dose being increased to* 1,000 *eggs per day from the age of* 118 *days.*

By the fifteenth day after this trial was commenced the droppings were diarrheal and blood-tinged. By the end of the fourth week the group in general had an unthrifty appearance, with dirty bedraggled feathers and pale combs and shanks. From about this point all except No. 72 commenced to recover, the plumage became brighter, and colour began to return to the combs. Following the increase in dose to 1,000 eggs on the sixtieth day these four birds again showed evidence of infestation, denoted chiefly by diarrhœa, occasionally blood-tinged, and by loss of colour in the combs, and by the dullness of the plumage. No. 72, on the other hand, became progressively weaker, and for five days during the eighth week remained squatting in one corner of the compartment, showing every appearance of advanced leg weakness. During the subsequent three weeks this bird showed a gradual recovery, but remained very unthrifty in appearance.

The weekly weights of this group are compared with those of the controls, Group X., in Table XII.

There is little to comment on in the comparison of the actual mean weekly body weights of the infested and control groups. The graphs (Graph No. 5 (A)) are divergent, showing that as the period of infestation is lengthened the differences between the actual mean weekly body weights of the two groups become increasingly greater in favour of the controls.

TABLE XII.

Group IX.

No. of Bird.	Weight in Ounces.											
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.	9th. Week.	10th. Week.	11th. Week.
72	17·5	20·5	23·5	22	20·5	24	27	28	27·5	30	32	34·5
73	17·5	20	23·5	27	28	33·5	38	43	44·5	48	52·5	54
74	18	20·5	25	28	31·5	36·5	41·5	45·5	48	51·5	56	58·5
75	17·5	19	22·5	25·5	27·5	31	36·5	39·5	40	44·5	46·5	48·5
76	16·5	18	20	21·5	23	26	33·5	36	38	42	42	45·5

Group X. (Controls).

No. of Bird.	Weight in Ounces.											
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.	9th. Week.	10th. Week.	11th. Week.
65	16·5	18·5	22·5	25·5	28·5	33·5	40	44·5	47·5	51	54	60·5
55	18	20	25	27·5	30	37	42	46·5	48·5	52·5	57·5	62
71	16·5	18·5	21·5	26	28·5	35	41	46·5	46·5	50	52	59
56	16·5	20	24·5	28	31	37·5	43·5	48	50·5	52·5	56	64·5
64	20·5	24·5	28	31·5	36	42·5	50·5	52·5	54	55·5	57·5	65·5

TABLE XII.—*continued.*

ANALYSIS OF GROUPS IX. AND X.

	Weight in Ounces.					
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.
Mean weekly weights, Group IX.	17·4	19·6	22·9	24·8	26·1	30·2
Mean weekly weights, Group X.	17·6	20·3	24·3	27·7	30·8	37·1
Mean gain in weight per week, Group IX.	..	2·20 ± 0·30	3·30 ± 0·42	1·90 ± 0·92	1·30 ± 0·82	4·10 ± 0·49
Mean gain in weight per week, Group X.	..	2·70 ± 0·44	4·00 ± 0·36	3·40 ± 0·33	3·10 ± 0·37	6·30 ± 0·34
Differences between mean weekly gains of Groups IX. and X.	..	+ 0·50	+ 0·70	+ 1·50	+ 1·80	+ 2·20
Significance of difference	..	N.S.	N.S.	N.S.	N.S.	S.

	Weight in Ounces.					
	6th. Week.	7th. Week.	8th. Week.	9th. Week.	10th. Week.	11th. Week.
Mean weekly weights, Group IX.	35·3	38·4	39·6	43·2	45·8	48·2
Mean weekly weights, Group X.	43·4	47·6	49·4	52·3	55·4	62·3
Mean gain in weight per week, Group IX. ..	5·10 ± 0·73	3·10 ± 0·68	1·20 ± 0·54	3·60 ± 0·33	2·60 ± 0·86	2·40 ± 0·33
Mean gain in weight per week, Group X. ..	6·30 ± 0·49	4·20 ± 0·59	1·80 ± 0·52	2·90 ± 0·49	3·10 ± 0·56	6·90 ± 0·70
Differences between mean weekly gains of Groups IX. and X.	+ 1·20	+ 1·10	+ 0·60	− 0·70	+ 0·50	+ 4·50
Significance of difference	N.S.	N.S.	N.S.	N.S.	N.S.	S.

The differences in amount of mean weekly gain also increased in favour of the controls to a significant difference of 2·20 oz. at the end of the fifth week. Thereafter, up to the increase in dosage on the sixtieth day, these differences show a gradual decrease until, during the ninth week, the gain by the infested birds is greater than that by the controls. Following the increase in dosage, the effect on Group IX. was apparently such that during the eleventh week the mean gain in weight by this group was significantly less (by 4·50 oz.) than that of the controls. Up to the time of the increase in dosage, the total mean gain by the controls was 8·90 oz. greater than that of the infested birds, which difference is approaching significance; the total subsequent mean gain was 5.00 oz. greater, and the total mean gain over the whole trial 13·90 oz. greater, both these differences being significant.

GRAPH No. 6.
(A)—Actual Mean Weekly Body Weights.

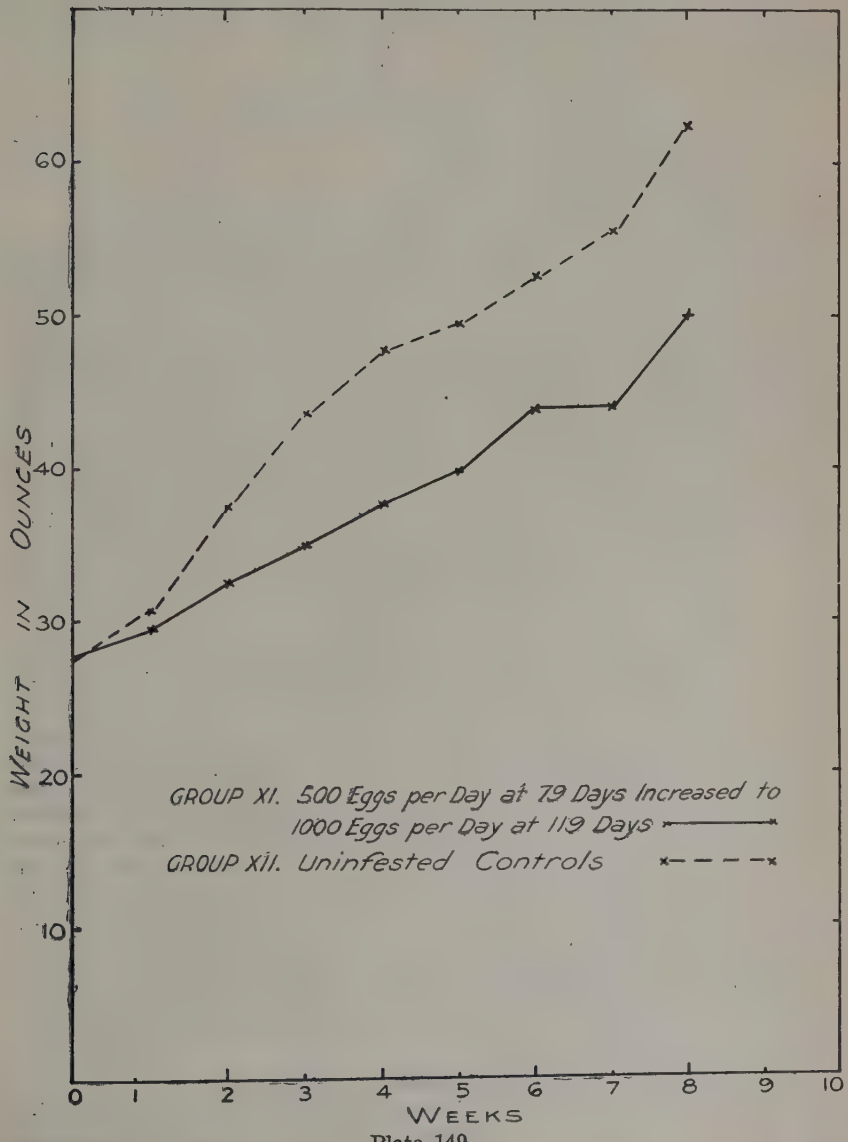


Plate 149.

(B)—DIFFERENCES BETWEEN MEAN WEEKLY GAINS IN WEIGHT OF GROUPS XI. AND XII.

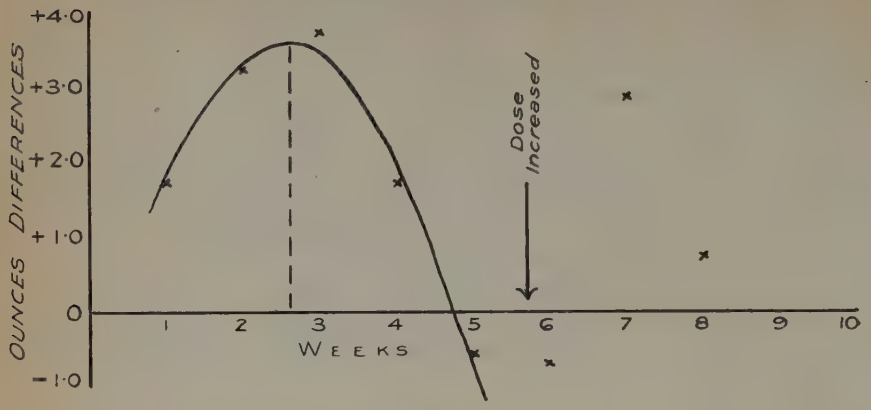


Plate 150.

$y = -1{\cdot}34 + 3{\cdot}77 \times -0{\cdot}73\,x^2$.

Turning-point when $x = 2{\cdot}6$.

$y = 0$ when $x = 4{\cdot}7$.

b and c significant (i.e.) upward and downward trends.

NOTE.—In Groups XI.-XII. a change in the trend occurred immediately after the increase in dose, and the first weighing after the change could not be fitted to the curve.

When these differences in amount of mean weekly gain between the two groups are plotted (Graph No. 5 (B)), a curve fits the points satisfactorily up to the time of the increase in dose. The turning point is during the fifth week, and the curve cuts the axis during the ninth week, indicating that during the fifth week the infested birds commenced to recover and continued to recover to such an extent that by the end of the ninth week the difference in amount of gain between the two groups had become zero. After the increase in dose the curve rises steeply, but although sufficient data is not available for an accurate analysis of this trend, it possibly indicates that the infested birds became rapidly reaffected by the increase in the dosage on the sixtieth day.

Group XI.—This group was given 500 *eggs per day from the age of seventy-nine days, the dose being increased to* 1,000 *eggs per day after a period of forty days.*

Twelve days after infestation the birds were somewhat depressed, the combs were pale and the plumage dull, and the droppings were diarrheal. During the next eight days the droppings showed evidence of intestinal hæmorrhage, and the birds had assumed a very marked unthrifty appearance. From this point, four of the birds commenced to recover, but were again affected with diarrhœa during the seventh week, following the increase in dosage. At the time of autopsy at the end of the eighth week these four birds were bright and active and passing normal-formed droppings. Chicken No. 80, however, failed to show any evidence of a recovery at any time, and by the end of the fourth week was so weak it could no longer stand or even squat, remaining lying on its side. This bird was autopsied on the point of death on the twenty-ninth day.

In the following table (Table XIII.), in which the weekly weights of this infested group and of its control are compared, chicken No. 80, which was removed from the infested group on the twenty-ninth day, is omitted.

TABLE XIII.

Group XI.

No. of Bird.	Weight in Ounces.								
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.
77	31·5	32·5	35	36·5	37·5	39·5	42·5	41	48·5
78	25·5	27·5	30·5	33·5	37	40·5	43·5	45	50·5
79	28·5	29·5	32·5	36	39·5	42·5	46·5	47·5	54·5
80	29·5	32	35	36·5	33	..	..	..	..
81	26	27·5	31·5	34	36	37	41·5	41·5	46·5

Group XII. (Controls).

No. of Bird.	Weight in Ounces.								
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.	5th. Week.	6th. Week.	7th. Week.	8th. Week.
65	25·5	28·5	33·5	40	44·5	47·5	51	54	60·5
55	27·5	30	37	42	46·5	48·5	52·5	57·5	62
71	26	28·5	35	41	46·5	46·5	50	52	59
56	28	31	37·5	43·5	48	50·5	52·5	56	64·5
64	31·5	36	42·5	50·5	52·5	54	55·5	57·5	65·5

TABLE XIII.—*continued.*
ANALYSIS OF GROUPS XI. AND XII.

No. of Bird.	Weight in Ounces.				
	At Infestation.	1st. Week.	2nd. Week.	3rd. Week.	4th. Week.
Mean weekly weights, Group XI.*	27·9	29·3	32·4	35·0	37·5
Mean weekly weights, Group XII.	27·7	30·8	37·1	43·4	47·6
Mean gain per week, Group XI.*	..	1·40 ± 0·24	3·10 ± 0·32	2·60 ± 0·44	2·50 ± 0·75
Mean gain per week, Group XII.	..	3·10 ± 0·37	6·30 ± 0·34	6·30 ± 0·50	4·20 ± 0·59
Differences between mean weekly gains of Groups XI. and XII.	..	+ 1·70	+ 3·20	+ 3·70	+ 1·70
Significance of difference	..	S.	S.	S.	N.S.

	Weight in Ounces.			
	5th. Week.	6th. Week.	7th. Week.	8th. Week.
Mean weekly weights, Group XI.*	39·9	43·5	43·8	50
Mean weekly weights, Group XII.	49·4	52·3	55·4	62·3
Mean gain per week, Group XI.*	2·40 ± 0·68	3·60 ± 0·46	0·30 ± 0·81	6·20 ± 0·81
Mean gain per week, Group XII.	1·80 ± 0·52	2·90 ± 0·49	3·10 ± 0·56	6·90 ± 0·70
Differences between mean weekly gains of Groups XI. and XII.	− 0·60	− 0·70	+ 2·80	+ 0·70
Significance of difference	N.S.	N.S.	S.	N.S.

* One bird (No. 80) which died early in the experiment was omitted.

The actual mean weekly body weights of the infected and control groups are compared in Graph No. 6 (A). This graph shows that the actual mean weekly weights of Group XI. were markedly affected by the infestation. The plotted points are strongly divergent for the first four weeks, but during the next two weeks become slightly convergent. The effect of the increase in dosage to 1,000 eggs on the fortieth day is readily seen by the appearance of the graph during the seventh week.

A consideration of the differences in the amounts of the mean weekly gains in weight of the two groups shows increasing and significant differences in favour of the controls during the first three weeks. During the fifth and sixth weeks, however, the mean gain in weight by the controls is overtaken by that of the infested birds. The increase in dosage on the fortieth day, then, apparently affected Group XI. to such an extent that during the seventh and eighth weeks the controls gained in weight to the greater amount, the difference at the end of the seventh week being significant. An analysis of the amounts of the total mean gain of each group up to the time of the dose increase on the fortieth day, subsequent to the dose increase, and over the whole period of the trial, respectively, shows that over these respective periods the controls had gained 9·0 oz., 3·6 oz., and 12·5 oz. more than the infested birds, all of which differences are significant.

When these differences in amounts of mean weekly gains are plotted, a curve can be satisfactorily fitted up to the last weighing before the dose increase (Graph No. 6 (B)). The turning point occurs during the third week, indicating that during this week the infested birds began to recover, so that towards the end of the fifth week, when the curve cuts the axis, the differences in amount of mean weekly gain between the two groups becomes zero. Subsequent to the increase in dose during the sixth week, the rapid rise and fall of the curve possibly indicates that the increase in dose was responsible for the birds becoming rapidly affected again and just as rapidly recovering, but not sufficient points were available for an accurate analysis of this trend.

Discussion.

The interpretation given to the results obtained from exposing these three groups of birds to a continuous infestation shows that whilst the infestation employed affected body weight and induced conspicuous symptoms of ascaridiasis in all three groups, it was also responsible for the development of a resistance which enabled the groups to recover to varying extents. It is felt that had the number of eggs given per day been considerably reduced, the development of this resistance would have been sufficiently delayed to give more accurate information regarding the behaviour of birds under natural conditions of hyper-infestation. The symptoms manifested did not differ in any way from those observed in birds subjected to a single infestation, except they were generally not so acute.

III. Clinical Symptoms and Lesions Associated with Infestation.

From the above studies on the pathogenicity of infestation with *A. galli*, assisted by observations on naturally infested birds, the clinical symptoms and lesions associated with infestation may be summarised as follows:—

Clinical Symptoms.

In young birds marked symptoms of infestation may be visible within the first week after coming into contact with infested soil. There is firstly an impaired appetite, and the birds show decreased activity and an abnormal thirst. Diarrhœa, paleness in the comb, loss of colour in the legs and of brightness in the plumage are evident. The feathers become ruffled, the wings droop, and the bird assumes a hunched-up, drowsy appearance (Plate 151.) As a consequence, growth is arrested.



Plate 151.

Young Bird, experimentally Infested with *Ascaridia galli*; Six days after Infestation.

During subsequent periods, the droppings continue to be diarrheal in consistency, and may show evidence of intestinal hæmorrhage. In those birds that recover some may show a voracious appetite and a rapid growth; others, however, may fail to grow to a normal extent, and remain stunted. If, however, the infestation is too severe to permit a recovery, the birds become progressively anæmic and emaciated. There is a gradual loss of strength, which may be eventually manifested by a conspicuous leg weakness, such birds walking with a staggering gait when disturbed, and eventually remaining prostrated till death intervenes, which may occur as early as during the second week after infestation.

In older birds a heavy infestation may be denoted by paleness of the comb and shanks, dull plumage, increased food consumption, and a decrease in egg production. Eventually, the birds become markedly anæmic and emaciated, and in some cases the weakness accompanying the disease may manifest itself as a form of "leg paralysis."* Unless

* NOTE.—On occasions spontaneous symptoms of "leg paralysis" may occur without warning, accompanied by severe enteritis.

other disease conditions intervene, however, death from ascaridiasis is much less frequent in old birds than in young birds.

Lesions.

Experimental infestations have shown that the macroscopic lesions associated with infestation are most prominent in the small intestine, liver, and kidneys.

Small Intestine.—The lesions visible in the small intestine in the early stages of infestation include minute hæmorrhages, larger and more deeply situated hæmorrhages, areas of congestion, distinct loss of muscle tone, and, in cases of long standing, marked thickening of the wall. The hæmorrhages and areas of congestion are situated in that portion of the intestine favoured as a habitat by the larvæ. The larger hæmorrhagic spots referred to are considered to be caused by the more deeply penetrating larvæ, and are most conspicuous when the intestine is viewed from the peritoneal surface. They are not very numerous, however, and in time gradually assume a whitish appearance, to eventually disappear entirely. In the latter stages they are somewhat similar to the nodules described by Itagaki,[67, 68] but have an entirely different distribution in the small intestine, and are in no way concerned with the development of the larvæ, as recorded by him.

In acute cases loss of muscle tone in the intestine and stomachs is very pronounced, and is usually accompanied by an enlarged, flabby heart, with fluid present in the pericardial sac and peritoneal cavity.

A heavy infestation with well-grown worms may cause a severe enteritis, sometimes restricted to that portion of the small intestine infested, with which loss of muscle tone and thickening of the wall may be associated.

Histological examination indicates patches of inflammatory reaction in the mucous membrane, with some degree of superficial erosion. In these inflammatory areas there is an accumulation of histiocytes and some polymorph neutrophiles, with fibroblastic proliferation and distention of the interstices of the connective tissue with moderate amounts of inflammatory exudate. The blood vessels in such areas are congested. The areas of infiltration are most marked towards the surface of the mucous membrane, but occasionally occur deep down near the basis of the glands. Others, again, spread diffusely from base to tip. Catarrhal changes are visible at the tips of the villi.

Sections of worms are seen lying free in the lumen of the gut, and some are also present in the glandular crypts, in the muscle layers, and in the mesenteric folds.

Liver.—The liver may be paler or darker than normal, and in severe cases may be noticeably enlarged. Small subcapsular hæmorrhages and whitish spots may be present.

Microscopic examination shows the presence of a moderate to marked congestion, fatty infiltration, with areas of histiocytic infiltration, mostly in the vicinty of the small vessels, though occasionally subcapsular.

Kidneys.—These may be paler than normal, and enlarged with distended ureters.

Histologically, the tubular epithelium shows cloudy swelling, and some of the convoluted tubules patchy, fatty degeneration. There is

endothelial proliferation in some of the glomerular tufts, and the cortex shows small areas of round cell infiltration, with tubular atrophy and degeneration. Moderate to diffuse congestion is present, and hæmorrhages of considerable size are seen between the cortical tubules.

Discussion.

A consideration of the life history of *A. galli* shows that the larvæ attack the intestine wall during the tenth to nineteenth day. The mechanical effects of this attack are shown microscopically by the degree of superficial erosion of the mucous membrane, the epithelium lining the crypts becoming entirely destroyed and permitting hæmorrhages into the lumen of the gut.

An interpretation of the histo-pathological picture presented by the liver and kidneys indicates the distribution of some blood-borne pathogenic agents to these organs, in which they have become localised, and have given rise to local aggregations of histiocytes with some general congestion and, in some places, small hæmorrhages also. Such a condition is no doubt the result of a toxæmia caused by the absorption of the waste products of the worms and their distribution throughout the body by the blood stream.

[TO BE CONTINUED.]

THE SELECTION AND MATING OF POULTRY BREEDING STOCK.

ALTHOUGH many poultrymen have already mated their birds for this season's operations they are urged to study these notes carefully, then check over their work, making sure that it has been well done. This suggestion is put forward, for breeding has a most important influence on the success or otherwise of the pullet harvest.

Before selecting breeding stock a thorough knowledge of the particular breed is essential. Therefore, if not conversant with it, obtain a copy of breed standards, illustrated, which is free on application to the Department of Agriculture and Stock.

Having in mind the type in accordance with the standard, select the birds to be used as breeders from among those which are typical. By keeping closely to the standard a more uniform flock will result. This first selection must be made while the bird is on the ground, at the same time taking notice of its action and movements, and bearing in mind that the active and alert bird is not only a good layer but is also an excellent breeder. Invariably it will be found that the dull, lazy bird, or one which spends much time resting on the perches or remaining stationary is a poor breeder as well as a poor layer. The good breeder-layer usually is first off the perch in the morning, last on the perch at night, with a full crop. The good male has similar habits, and besides being somewhat pugnacious he is very attentive to his hens.

Constitutional vigour and stamina are most important characteristics to aim at in breeding, birds strong in these features being essential to produce fowls that will live and lay. On the other hand, any weakness in the parents will produce weak birds, resulting in a very heavy mortality, also a rapid degeneration of size of birds and average egg production. These features are indicated by general habits, as already explained.

Size of Body, Shanks, and Head.—The body of a strong bird is long, wide, and deep, these measurements being proportionate with each other; full fronted, full abdomen, with fairly close-fitting plumage. The most common faults in weak birds are narrow and shallow bodies, cut-away chest or tucked-up abdomen, and loose plumage. The strong bird always has strong shanks without coarseness, and the legs well apart. The weak bird has spindle shanks, possibly loose-jointed or stilty.

The head is also an excellent guide in the selection of breeders. It indicates the nervous temperament, health, and also stamina and constitutional vigour. The head should indicate strength, be of medium size, proportionate in length, depth, and thickness. Principal faults: Very large and coarse, long and shallow, small and narrow. The eye should be bright, full, prominent, and expressive; avoid making use of birds with beetle brows, almond-shaped or sunken eyes, or greenish-coloured eyes in a bird that should have red eyes, or red eyes in a bird that should have dark eyes. The face of a good bird is full and free from wrinkles, bright, red, and usually free from feathering. The poor bird is indicated invariably by reverse characteristics. The beak of a good bird is of medium length, strong and nicely curved, whilst a short, thick or long, straight beak indicates weakness.

The number of hens to mate with a male depends on the breed, age, and vigour of that bird. Light breeds, such as White Leghorns—a vigorous cockerel could have twenty hens, cock ten to twelve, dubbed cock fourteen to sixteen. Heavy, utility breeds, as Australorps—cockerel fourteen to sixteen, cock eight to ten.

THE NECESSITY FOR CULLING.

Poultry breeders generally appreciate the necessity of giving careful consideration to the selection of the stock that are to be used for breeding purposes in order to ensure, as far as possible, the production of birds that will inherit the ability to lay. The same consideration, generally speaking, is not given to the laying ability of the flock as a whole. It does not necessarily follow that even the best of our stock will transmit laying characteristics sufficiently desirable to justify the retention of all their progeny.

Again, the laying ability of any individual can be marred by incorrect management, disease, and parasitical infestation during its growing period. These several factors necessitate the culling of individuals.

Culling is not a practice that can be regulated to one period of the year. To obtain the best results it is necessary for it to be continuous. It must be applied equally to young and old, commencing from the time the chicken is hatched.

Culling is more essential just now than at almost any period in the history of the poultry industry in this State, owing to the reduced profit per unit that naturally follows a fall in egg values and an increase in fodder prices. This condition arises yearly, it is admitted, but the great increase in fodder values during the past few months calls for particular attention.

On many farms will be found 5 per cent. of culls, and on others again a percentage far in excess of this. Flocks of a thousand birds carrying only 5 per cent. of culls cost their owner an additional 30s. per month. This may not be much to many individuals, but if those engaged in the industry as a whole were to keep their flocks well culled, it would reduce the demand upon the fodder available, with the consequent reduction in costs.

The regular and frequent culling of individual flocks would also give a better spread of the birds that are to be disposed of for table purposes. It would prevent to some extent the glutting of the market during the early months of the year, and by doing so increase the value by some pence of a great proportion of the birds that are sold for table purposes.

Poultry raisers as a whole should make a careful study of feeding in order to obtain the best possible production from their flocks. The same careful study is necessary in relation to the birds they feed.

Principles of Botany for Queensland Farmers.

C. T. WHITE, Government Botanist.

[*Continued from p. 228, August, 1936.*]

CHAPTER V.

The Inflorescence or Flowering Shoot.

THE previous chapters have dealt mainly with vegetative shoots. More particular attention is now devoted to the flowering ones. Flower buds originate in the same way as leaf buds, and like them are terminal or axillary.

In some trees, as in the Moreton Bay Chestnut or Black Bean



Plate 152.

VARIOUS POSITIONS FOR THE INFLORESCENCE.

1. On the old wood (Black Bean—*Castanospermum*).
2. Terminal (Crow's Ash—*Flindersia*).
3. Terminal and axillary (Yellow Stringybark—*Eucalyptus acmenioides*).
4. Leaf-opposed (Pepper Vine—*Piper novæhollandiæ*).
5. Axillary (Red Ash—*Alphitonia excelsa*).
6. Supra-axillary (*Glochidion Ferdinandi*, var. *supra-axillaris*).

(Inflorescences such as Nos. 1 and 6 which are not terminal nor borne in a leaf axil are commonly described as *lateral*.)

[*Photo.: Department of Agriculture and Stock, Brisbane, from "Elementary Text-book of Australian Forest Botany."*]

(*Castanospermum australe*) (Plate 152, fig. 1), the flowering shoots spring from the older branches from which the leaves have fallen, or they may be developed, not only on the older branches, but on the trunk, as in the Cluster Fig (*Ficus glomerata*), Wild Apple (*Eugenia cormiflora*), &c.



Plate 153.

A Wild Apple Tree (*Eugenia cormiflora*) in the jungle, Malanda, North Queensland. [*Photo.: Queensland Government Tourist Bureau.*

(Plate 153); when developed opposite to a leaf, as in different species of Piper, they are said to be leaf-opposed (Plate 152, fig. 4); when developed in a leaf axil they are said to be axillary (Plate 152, fig. 5).

The flowering shoot often branches and rebranches, and produces not only one, or several, but sometimes thousands of flowers. The collection of flowers thus formed—whether only one, several, or numerous—is termed the inflorescence.

In its simplest form the inflorescence is composed of only one flower, in which case the flowers are described as solitary. They may be terminal,

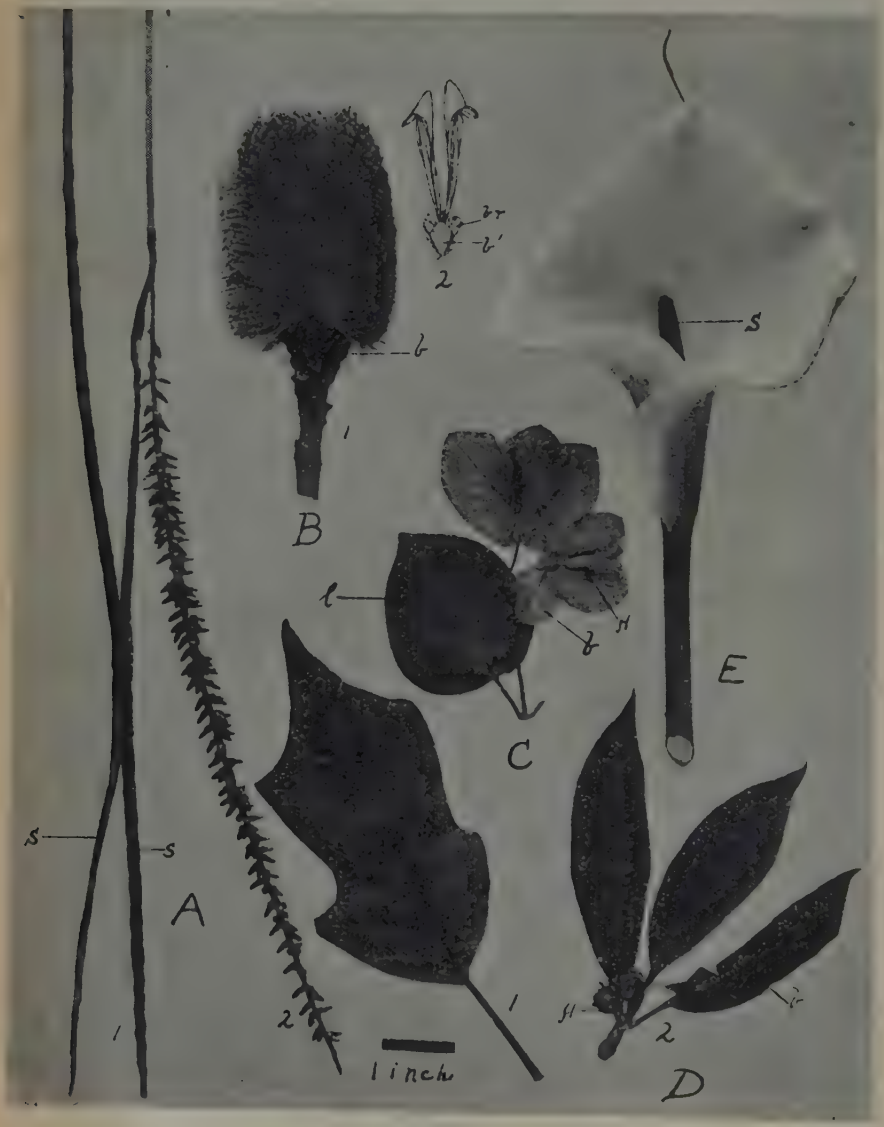


Plate 154.

[*Photo.: Department of Agriculture and Stock, Brisbane, from "Elementary Text-book of Australian Forest Botany."*

as in the native *Crinum uniflorum, Hibbertia* spp. (Guinea Flowers), &c., or they may be axillary, as in different species of Geebung (*Persoonia*) and Wild May (*Leptospermum*).

Generally speaking, however, it develops a branch system, and may be described as many- or few-flowered, and much- or little-branched, according to the development reached.

The stalk on which is borne a solitary flower, or the primary stalk of a compound inflorescence, is termed the peduncle, while the secondary branches or stalks are termed pedicels, and the central or main axis from which the lateral branches spring is the rhachis. When borne on a peduncle the inflorescence is said to be pedunculate, and when borne on pedicels the flowers are said to be pedicellate, or they may be without a stalk and seated directly on the rhachis or member from which they spring, as in the Tea Tree (*Melaleuca*) or Bottlebrush (*Callistemon*), when they are termed sessile.

Bracts and Bracteoles (Plate 154).—In most branched inflorescences it will be observed that the branches spring from the axils of variously modified leaves, usually smaller than foliage leaves, but sometimes green and fairly large, when they perform the same duties as foliage leaves. At other times they may be large and coloured, as in the Poïnsettia (*Euphorbia pulcherrima*) (Plate 154, fig. D), where they are a bright red, the Flannel Flower (*Actinotus*) (Plate 155, fig. 1), where they are white or cream-coloured, or Bougainvillea (Plate 155, fig. C), where they are purple or red.

These modified leaves subtending branches of the inflorescence are termed bracts, and those borne on the ultimate branches or under the individual flowers are bracteoles. Sometimes they fall away before or soon after the full development of the flower. In *Casuarina* (She-oaks) they are persistent, and with the development of the fruit become hard and woody, and welded together with the rhachis forming the "cone" borne by these trees.

DESCRIPTION OF PLATE 154.

Bracts and Bracteoles.

A. Walking-stick or Midgen Palm (*Bacularia*).
   1. Young flower spike enclosed in the spathe.
   2. The same further advanced; *s*, spathe.

B. *Banksia Robur.*
   1. Inflorescence.
   2. A pair of flowers (the flowers are arranged in pairs packed closely on the rhachis); *b*, bracts at the base of the inflorescence; *b'*, secondary bract subtending each pair of flowers; *br*, bracteoles subtending each single flower.

C. *Bougainvillea.*
   1. Ordinary foliage leaf; *b*, bright-coloured red or purple bracts; *fl* flower adnate to a bract.

D. Poinsettia (*Euphorbia pulcherrima*).
   1. Ordinary green foliage leaf.
   2. Flowering branchlet; *fl*, flowers; *b*, large red bract.

E. *Richardia æthiopica* (Calla or Arum Lily); *s*, spadix or spike of flowers enclosed in the big white spathe.

In other cases the whole inflorescence when young may be enclosed in a large bract distinguished by the term spathe; it may be tough and strong, as in the Palms (Plate 154, fig. A), or membranous, as in many of the Lily and Amaryllis families. It may be white and conspicuous, or coloured, as in the Arum or Calla Lilies (*Richardia*) (Plate 154, fig. E).



Plate 155.

SOME INFLORESCENCES SUPERFICIALLY ALIKE BUT OF SOMEWHAT DIFFERENT STRUCTURE.

1. Umbel of Flannel Flower (*Actinouts Helianthi*). The flowers (*fl*) are small and crowded together, and surrounded by an involucre of woolly bracts (*b*); *ped*, peduncle; *m*, a single male flower from an outer row of the umbel; *f*, female flower from the centre of the umbel; *p*, pedicel; *o*, ovary.
2. Heads or Capitula of a Western Australian Everlasting (*Helipterum Manglesii*). The flowers are small and crowded together in a head (*c*) surrounded by several rows of bright-coloured imbricate bracts (*b*); *b'*, a single bract from an inner row of the involucre; *fl*, a single flower.
3. Heads or Capitula of the Swan River Daisy (*Brachycome iberidifolia*). The involucral bracts (*b*) are small; the flowers are in a close head or capitulum (*c*); those of the outermost row (*r*) have bright-coloured, strap-shaped corollas; those of the inner row are small and insignificant; fl^1, a ray floret or flower of the outer row; fl^2, a disk floret or flower of the centre.

[Main figures all reduced to the same scale, analytical details enlarged to various extent. Nos. 2 and 3 adapted from Hooker, in the "Botanical Magazine."]

In Hibiscus the bracteoles form a whorl immediately below the flower, forming what is termed an epicalyx. The calyx and epicalyx together form the edible part of the Rosella (*Hibiscus Sabdariffa*). Sometimes one or more series of bracts may form a whorl or whorls under a head of flowers, as in the Dahlia, Zinnia, Aster, &c., or at the bases of flowering branches, as in the Carrot, Parsley, &c.; such a collection of bracts is termed an involucre, and the individuals forming it are known as involucral bracts. In the Noogoora Burr (*Xanthium pungens*) and in Bathurst Burr (*Xanthium spinosum*) the involucral bracts are united into a hard, ovoid involucre covered with hooked spines and enclosing the fruits. In the Everlastings (*Helichrysum* and *Helipterum* spp.) (Plate 155, fig. 2), in the Flannel Flowers (*Actinotus*) (Plate 155,

fig. 1), and some other plants, the bracts of the involucre are large and petal-like and sometimes brilliantly coloured, and give to the inflorescence whatever distinctive beauty it possesses.

In some plants a gradual change may be traced from the ordinary foliage leaves to the bracts; in others there is no such gradation, but the bracts or bracteoles are immediately marked off as very distinct, as in Hibiscus, Bougainvillea, &c.

Main Types of Inflorescence.—Inflorescences are classified according to their system of branching; they branch in various ways and take on different forms, but on the whole can be grouped under the two main heads of—

(*a*) Racemose (indefinite).—There is a distinct main axis or rhachis on which a number of flowers are developed in regular succession.

(*b*) *Cymose* (definite).—The main axis is short and terminates in a flower, lateral branches being produced, and the energy of growth, instead of being devoted to the main rhachis, is transferred to these lateral branches, so that they usually grow more vigorously than the primary axis from which they arose.

The racemose inflorescence is often called the indefinite inflorescence, because the axis goes on elongating after the first flower has been formed; it is also known as the centripetal inflorescence, as the flowers open from without inwards; this is more easily observable in a widened flower-head, such as that of Sunflower, Lantana, or other plant where the older flowers are on the outside and the younger in the centre, than in narrow inflorescences like those of the Macadamia or Queensland Nut, Snakeweed (*Stachytarpheta*), &c., where the oldest flowers are at the bottom and the youngest at the top.

In the cymose inflorescence the main axis is terminated by a flower, and its further elongation is checked, development being by the formation of successive lateral branches, the ends of which are terminated in the same way; hence inflorescences of the cymose type are often called definite. Naturally, in such a branch system, the oldest flowers are in the centre and the youngest outside, so that the central flowers open first and the others in succession outwards or centrifugally, and such inflorescences are called centrifugal.

Types of Racemose Inflorescences.—1. Spike (Plate 156), when the main axis is elongated, unbranched, and bears a number of sessile flowers, as in the Black Wattle (*Acacia Cunninghamii*), Mulga and some other wattles, Red Bottle Brush (*Callistemon*), Broad-leaved Tea Tree (*Melaleuca*), &c.

The spadix (plural spadices) only differs from the spike in having a thick and fleshy rhachis; it is generally enclosed in a spathe, as in the Arum Lily (Plate 154, fig. E) and Cunjevoi.

The catkin or amentum (plural amenta) (Plate 156, figs. 5 to 10) is a spike of unisexual flowers which usually falls off entire from the plant after flowering and fruiting, as in the Pines, Willows, She-oaks, &c.

2. Raceme (Plate 159), when the rhachis is elongated, unbranched, and bears a number of stalked flowers, as the Darling Pea (*Swainsona*), Macadamia Nut.

3. Corymb, when the main axis is comparatively short, and the lower flowers are borne on successively longer stalks than the upper, so that the top of the inflorescence is more or less on a plane, as in the Candytuft. This form is not very well marked, for often the rhachis elongates in fruit to assume the more ordinary racemose type of inflorescence, as is the case in the example quoted.



Plate 156.

SPIKES.

1. Spike of White Beefwood (*Orites*).
2. Spike of Black Wattle (*Acacia Cunninghamii*).
3. Flowering and
4. Fruiting spike of Paper-barked Tea Tree (*Melaleuca viridiflora*).
5. Male and
6. Female amenta of *Casuarina suberosa* (She Oak).
7. Male amenum of the Hoop Pine (*Araucaria Cunninghamii*).
8. Male amenta of Chir or Long-leaved Pine (*Pinus longifolia*).
9. Male and
10. Female amentum of Black Willow (*Salix nigra*).

[*From "Elementary Text-book of Australian Forest Botany."*

4. Umbel (Plate 157, figs. 1-4 and 9-11), when the main axis or stalk develops a number of stalked flowers from its apex; the flower-stalks which thus radiate out are termed the rays of the umbel; the umbel may be simple, when each ray bears a single flower, as in some Eucalypts, or compound (Plate 157, fig. 11), when each ray bears a secondary umbel—termed an umbellule (as in Parsley, Bishop's Weed, Fennel, &c.). Often the rays of an umbel bear at their base a number of bracts, forming an involucre, and the umbellules in their turn also bear a number of bracts forming an involucel.



Plate 157.

UMBELS AND HEADS (CAPITULA).—Umbel of Yellow Stringybark (*Eucalyptus acmenioides*). 2 and 3. Umbels of *E. Planchoniana*. 4. Flowering and 5. Fruiting umbel of White Stringybark (*E. eugenioides*). 6. Flowering and 7. Fruiting umbel of Brown Stringybark (*E. capitellata*). 8. Fascicle of heads of Brigalow (*Acacia harpophylla*) ; A. A single head or capitulum. B. A single flower (both enlarged). 9 and 10. Umbels of Brush or Scrub Beefwood (*Stenocarpus salignus*). 11. Compound umbel of *Apium australe* ; *p*, peduncle ; *p'* secondary peduncle ; *ped* pedicel. It is often very difficult to distinguish between a head and an umbel, especially in the inflorescences of such plants as the eucalypts, where the calyx-tube gradually merges into the pedicel, the latter being very short, but is usually more easily discernible in fruit as in *E. eugenioides* and *E. Planchoniana* figured above.

—[*From "Elementary Text-book of Australian Forest Botany."*

In the umbel of *Actinotus* (Flannel Flower) (Plate 155, fig. 1) it is the bracts of the involucre which give to it its peculiar appearance and form the larger part of the "flower," which in this case is really a collection of small flowers surrounded by a conspicuous involucre.

5. Head or capitulum (Plate 157, figs. 5-8).—The main axis or stalk of the inflorescence bears a number of sessile flowers at its apex, forming a compact cluster, as in the Turpentine (*Syncarpia*), many Eucalypts, and Wattles.

Often, as in the Dahlia, Thistle, Cape Weed (and other plants of the family *Compositæ*), the flower-head is subtended by a number of bracts forming an involucre. The shortened and modified rhachis on which the flowers are borne is flattened out, and may be flat, convex, or conical, and is often called the receptacle. Small scale-like bracts are often formed, subtending the individual flowers in the head.



Plate 158.
Green Cestrum (*Cestrum parqui*).

6. Panicle (Plate 158), when the main axis gives off a number of branches, each bearing two or more flowers. The term is one in very general use in descriptive botany, being applied to many compound or much-branched inflorescences. It may be narrow and spike-like, as in some grasses—e.g., Parramatta or Rat's Tail grass (*Sporobolus Berteroanus*)—or wide and spreading, as in species of *Flindersia*, &c.; when the flowers are borne more or less on a plane, as in some species of *Pavetta*, *Ixora*, and *Pittosporum*, it is said to be corymbose or corymbosely branched.

When the flowers in a raceme or branch of a panicle are all turned to or borne on one side of the rhachis, the raceme or panicle branch is said to be unilateral, while the flowers themselves are said to be secund, as in the Silky Oak (*Grevillea robusta*) and Black Bean (*Castanospermum*) (Plate 159, fig. 4).



Plate 159.
Racemes.

1. Macadamia Nut (*Macadamia ternifolia*); the flowers are arranged in pairs along the rachis; a pair of flowers is shown at A.
2. A flowering and
3. A fruiting raceme of the Red Carrabin (*Geissois Benthami*); A, single flower.
4. Black Bean (*Castanospermum australe*); *ped*, pedicel; *r*, rachis.

[*From "Elementary Text-book of Australian Forest Botany."*

A thyrse is a form of mixed inflorescence in which the main or central axis is indefinite, but the secondary and ultimate branches are definite or cymose. Examples: White Beech (*Gmelina*), Wild Ginger (*Alpinia cærulea*).

Types of Cymose Inflorescences.—The principal kinds of cymose inflorescences are:—

Dichotomous Cyme (Plate 160, fig. 1).—Here the main axis terminates in a flower, beneath which two lateral branches of equal development are formed. These generally grow more vigorously than

the main axis, and repeat the same process. Where three lateral branches are produced instead of two, the inflorescence is known as a trichotomous cyme. (Plate 160, fig. 2).



Plate 160.

CYMOSE INFLORESCENCES OF SOME COMMON AUSTRALIAN TREES.

1. Dichotomous cyme of Swamp Mahogany (*Tristania suaveolens*).
2. Trichotomous cyme of *Acronychia lævis*.
3, 4, and 5. Scrub Stringybark (*Rhodamnia trinervia*), showing range from a simple three-flowered cyme to panicled cyme.

[Note that in these inflorescences the oldest flowers are always in the centre.]

[*From "Elementary Text-book of Australian Forest Botany."*

Fascicle (Plate 161) is a term commonly applied to flowers or flowering shoots that arise in a cluster, and the true nature, whether racemose or cymose, cannot readily be determined. Examples: Pepper Bush (*Drimys*), Black Apple (*Sideroxylon australe*), Milky Plum (*Niemeyera prunifera*), &c.

The forms of inflorescence met with in plants are very numerous, and are not always easily made out at once. Thus, a panicle may simulate a spike, when it is spoken of as a spike-like panicle, or it may be raceme-like or umbel-like, according to which form of inflorescence it most superficially resembles.

CHAPTER VI.

The Flower.

The flower may be regarded as a shoot of limited growth, the parts of which are specially modified for the work they have to perform —that of reproduction.

Parts of a Complete Flower (Plate 162).—A complete flower, if examined, is seen to consist of four whorls of members, usually of very distinct appearance the one from the other. Particularising these whorls, commencing with the outside one, they are—

1. Calyx—generally green—may be a cup, or lobed or toothed, or divided into a number of distinct parts called sepals.



Plate 161.
Coondoo (*Sideroxylon Richardi*).
The flowers of this tree and others of the same family are borne in fascicles in the leaf-axil.

2. Corolla—usually white or coloured; like the calyx, it may be tubular, lobed, or divided into a number of distinct parts, in this case called petals, which usually alternate with the sepals—i.e., the middle or central line of a petal is generally over the interval between two sepals. The chief function of the calyx and corolla in the bud stage of the flower is to protect the inner parts or reproductive organs of the flower.

3. Andrœcium consists of a number of stamens, the male organs of the flower; each typically consists of a swollen portion, the anther, borne on a slender stalk, the filament. The anther is full of a yellow

powder, the pollen, consisting of a number of minute pollen-grains, the male fertilizing bodies necessary to the production of fertile seed. The filaments may be absent, when the anthers are said to be sessile; combined in a tube (staminal column), as in the White Cedar (*Melia*); united into bundles, as in the Brush Box and Mahogany (*Tristania*); slightly coherent in a ring at the base, as in the Red Bottle-brush (*Callistemon viminalis*); or, as is most often the case, may be altogether free.

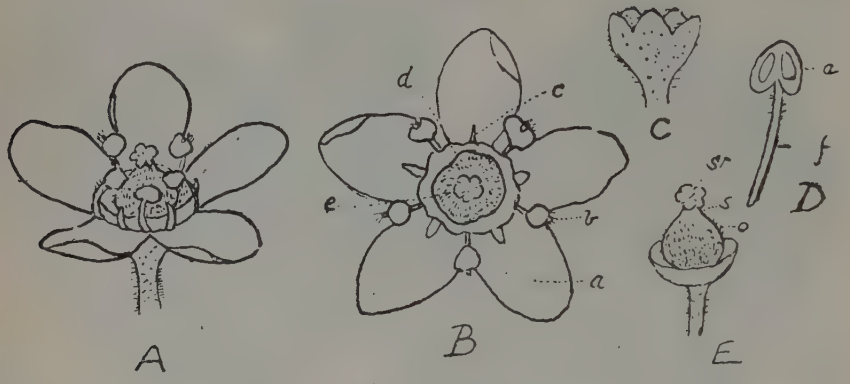


Plate 162.

PARTS OF A COMPLETE FLOWER—*Flindersia Oxleyana* (YELLOW WOOD).

A. Flower, side view.

B. Flower laid out to show parts; *a*, petal, the five petals constitute the corolla; *b*, stamen; *c*, staminode, the stamens and staminodes constitute the *androecium*; *d*, torus, disc, or thalamus (floral receptacle); *e*, *gynæceum* or *pistil*.

C. Calyx (hidden in the other figures by the petals).

D. Stamen consisting of a slender filament (*f*) topped by a somewhat heart-shaped anther (*a*).

E. Pistil (*Gynæcium*) consisting of the ovary (*o*), a very short style (*s*), and a comparatively large terminal stigma (*st*).

[All figures enlarged and adapted from illustrations in Maiden's "Forest Flora of New South Wales.]

4. The Gynæceum or pistil consists of one or more carpels, or female organs of the flower. Typically the pistil consists of a swollen basal portion, the ovary (which eventually develops into the fruit). It contains a number of small, rounded bodies, the ovules (which eventually develop into seeds); an elongate, stout, or slender neck, termed the style, which terminates in a more or less expanded apex, the stigma. Often the style is very short, as in *Flindersia* (Teak or Crow's Ash, Yellow Wood, &c.), or may be quite absent, as in the Mangosteens (*Garcinia* spp.) and species of *Capparis* (Bumbil Tree or Native Pomegranate, Mulpup, &c.), when the stigmas are said to be sessile.

The floral receptacle, on which are inserted the members just described, is known as the torus, and must not be confused with the receptacle of the inflorescence (p. 366). The disk or disc is a thickening of the receptacle at the base of the pistil, and is usually either cupular (i.e., cup-shaped), as in *Dysoxylon*, or a flat, fleshy disc, as in *Flindersia, Elæocarpus*, &c.

The disk may be entire, toothed or lobed, or divided into a number of parts. When the parts of a disc are distinct they are termed glands;

often they secrete a sugary fluid known as nectar, and the glands themselves are known as nectaries. Nectaries are not confined to the disc, but may be developed on the petals as pits or scales, or be merely a secreting surface.

Together the calyx and corolla constitute the perianth. In descriptive works on botany, such as "Queensland Flora," the term perianth-leaves or perianth segments is often used to denote parts of a perianth where their true character, whether sepals or petals, is not obvious; when sepals are white or coloured and conspicuous they are said to be petaloid—e.g., Christmas Bush (*Ceratopetalum*); similarly, when petals are green and insignificant they are sepaloid.

The calyx and corolla are spoken of as the non-essential, and the stamens and pistil as the essential parts of the flower.

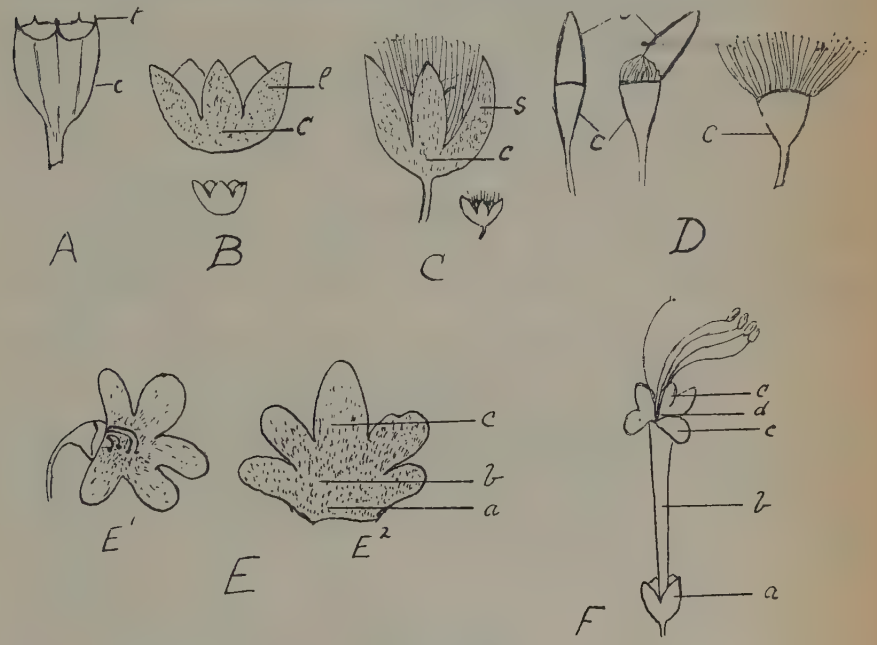


Plate 163.

GAMOPHYLLUS PERIANTHS.

A. Calyx of Apple Tree (*Angophora*), toothed; *c*, calyx tube; *t*, teeth.

B. Calyx of Crow's Ash (*Flindersia*), lobed; *c*, calyx tube; *l*, lobes.

C. Calyx of Red Carrabin (*Geissois*) parted; *c*, the very short, connate base; *s*, segments.

D. Different stages in a Eucalyptus flower; *c*, calyx tube; the calyx lobes are coherent into a cup or operculum (*o*), and fall off when the stamens attain maturity.

E. Flower of White Beech (*Gmelina*); E^1, an individual flower; E^2 corolla laid open; *a*, the very short corolla tube; *b*, the throat; *c*, corolla lobes or limb.

F. Flower of *Clerodendron floribundum*; *a*, calyx; *b*, corolla tube; *c*, corolla lobes or limb; *d*, throat. The smaller figures alongside B and C represent natural size; all the other figures are approximately natural size.

The Gamopetalous condition (E and F) is a very important one in plant classification, as all plants possessing such belong to a class distinguished from those with free petals; the gamosepalous condition, on the other hand (A-D), is a common feature in many plants, and little importance is attached to it in systems of plant classification.

[*From "Elementary Text-book of Australian Forest Botany."*

Special Terms Applied to Flowers.—A flower is hermaphrodite or bisexual when in possession of both stamens and pistil; unisexual when one sex, either androecium or gynæceum, is absent or imperfect; male when the gynæceum or pistil is absent or imperfect; and female when the stamens are absent or imperfect.

When an individual plant possesses only flowers of one sex, either male or female, the species is said to be dicœcious—that is, the male and female flowers are always borne on distinct individuals, as in the Date Palm, *Cycadaceæ*, or "Zamia Palms," Carob Bean (*Ceratonia*), &c.; when the flowers are unisexual, but both occur on the same individual, the plant is said to be moncœcious, as in most Pine trees, Kurrajong, Flame Tree, &c.; and when both unisexual and hermaphrodite flowers are borne on the same individual plant it is said to be polygamous, as sometimes happens in the Papaw.

Cohesion and Adhesion.—Owing to the crowding of the different parts of the flower, the members often cohere at their bases or for some distance along the whole length. When describing a flower the perianth segments are said to be connate at the base, connate to or beyond the middle, connate for a third of their length, or nearly to the apex, and so on.

When the perianth consists of connate leaves it is said to be gamosepalous or gamopetalous, as the case may be.

The union of like parts, such as sepals with sepals, petals with petals, &c., is known as cohesion, and the parts so fused are said to be connate.

In gamophyllous perianths (Plate 163) there is a distinct narrow, basal portion called the perianth-, calyx-, or corolla-tube, as the case may be; the upper, expanded portion is termed the limb. The calyx or corolla may be toothed when connate for nearly the whole length with small teeth at the apex—e.g., the calyx of the Bean Tree; cleft or lobed, when connate for some distance, with larger divisions in the upper part—e.g., corollas of *Jasminum* and *Clerodendron*; or parted or partite, if divided nearly to the base—e.g., the calyx of Red Mangrove (*Rhizophora*), Christmas Bush (*Ceratopetalum*), &c.

The union of members of one whorl with members of another—as stamens with petals—the former appearing as if they had grown out of the latter, is known as adhesion, and the members so fused are said to be adnate—e.g., the capsule of Eucalyptus and allied plants is said to be adnate to the calyx tube.

The position of the other whorls of the flower in relation to the gynæceum is of considerable importance in plant classification.

When there is no adhesion and the perianth and androecium are placed under the ovary, the sepals, petals, and stamens are said to be hypogynous or inferior, and the ovary is described as superior; or the whole may be referred to as a hypogynous flower, as in peas and beans. In the flower described as epigynous the other floral whorls, instead of being under or round the gynæceum, are adherent to and placed above it, the ovary being inferior, as in the Guava and Coffee.

Symmetry of Flowers.—When all the members of the individual whorls of floral leaves are similar and equal in size to one another, the flower is regular, as in the flowers of a single rose, apple, &c.; when the various members are unequal in shape and size or unequally spaced round the central axis, the flower is irregular, as in peas and beans,

Sweet Pea, &c.; in general descriptive works the terms regular and irregular are more or less confined to the perianth and more particularly to the corolla, slight inequalities in the members comprising the androecium and gynæceum not preventing the flower being referred to as regular; the terms regular and irregular are also applied in the same sense to the individual whorls of the flower. Illustrations of regular and irregular flowers are shown in Plate 164.

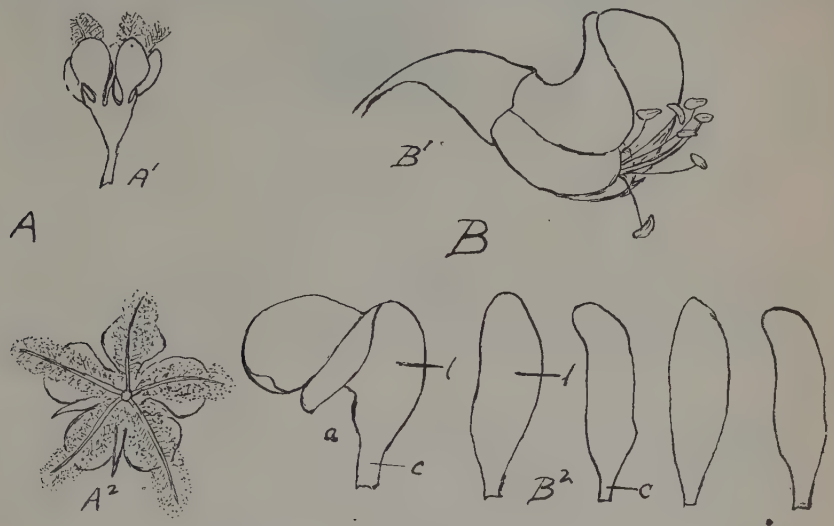


Plate 164.

Regular and Irregular Flowers.

A. Scrub or Brush Box (*Tristania conferta*). A^1, single flower; A^2, flower flattened out. There are five calyx lobes, approximately equal, five petals, and five bundles of stamens, similarly equal.

B. Black Bean (*Castanospermum*). B^1, single flower; B^2, the five petals. The back petal (*a*) is very dissimilar to the other four, and the corolla is markedly irregular.

The petals of the Black Bean are slightly clawed (unguiculate); *c*, claw; *l*, lamina.

[*From "Elementary Text-book of Australian Forest Botany."*

Aestivation (Plate 165).—The arrangement of the different floral members in the bud is called æstivation. The æstivation of the sepals

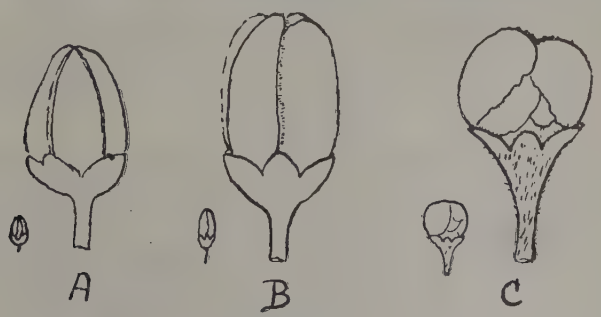


Plate 165.

Aestivation.

A. Valvate petals of *Pentaceras australis* (Bastard Crow's Ash or Teak).

B. Slightly imbricate petals of Red Cedar (*Cedrela*).

C. Very imbricate petals of Swamp Mahogany (*Tristania suaveolens*).

[The smaller figures represent natural size.]

and petals or the free parts of the calyx and corolla is crumpled when irregularly folded, as in the petals of the Poppy; valvate, when their margins are placed against each other in the whorl but do not overlap; and imbricate, when the margins overlap.

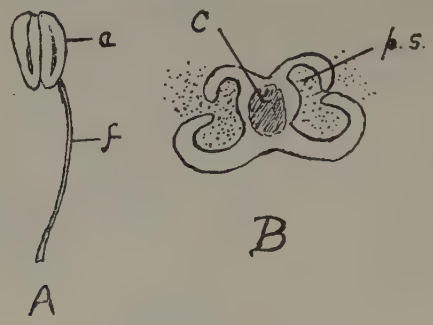


Plate 166.

A. A typical stamen (*Eucalyptus calophylla*); *a*, anther; *f*, filament.
B. Transverse section of the anther; *c*, connective; *p.s.*, pollen-sac.
[Both enlarged and adapted from illustrations in Mueller's "Eucalyptographia."]

Stamens (Plate 166).—As previously noted, a typical stamen consists essentially of an anther borne on a slender stalk—the filament.

The anther in its typical form consists of two longitudinal halves or lobes called anther-lobes, each of which, at least when young, consists of two cells or chambers which contain the dust-like pollen, and are called the pollen-sacs.

Anther lobes usually open in a longitudinal slit, and occasionally —as in the Potato and other species of *Solanum*, some Eucalypts, &c.— by small openings called pores. The shedding of the pollen by the anther, either by splitting or by pores, is called its dehiscence.

The anther lobes are placed on the right and left sides of a connecting strip of tissue known as the connective. This is sometimes continuous with the filament, and is usually narrow, but at times is comparatively wide. Occasionally it is continued in the form of a small appendage the presence or absence of which in closely-allied plants is often a ready means of identification.

The filament is not always long and slender; sometimes it is flattened and nearly as broad as long, as in the Ivory Wood (*Siphonodon*). In the Castor Oil plant (*Ricinus*) and some other *Euphorbiaceæ* the stamens are very much branched.

Staminodia.—Sometimes the anther is absent or rudimentary, and the sterile filament is called a staminodium or staminode, the number, size, and shape of which in the androecium are often important points to note in distinguishing closely-allied plants. In different species of *Flindersia* (Crow's Ash, Yellow-wood, Cudgerie, Maple, &c.), for instance, the five perfect stamens of the flower alternate with five staminodia. (See Plate 163.) Occasionally more than one form of staminode is present in a flower, as in some Laurels—e.g., native species of *Cryptocarya*, where there is an outer row of six club-shaped and an inner row of three cordate or pointed staminodia.

Pollen.—Pollen is usually in the form of a dust or powder, which viewed under the microscope, is seen to be composed of a number of pollen-grains, the shape and size of which vary considerably in different species of plants. The surface is often very beautifully sculptured, warted, grooved, &c.

Gynæceum.—The gynæceum or pistil is the inner essential part of the flower, and is the most complex and highly modified of the floral members.

As previously stated, the pistil consists of one or more carpels.

A pistil consisting of one carpel is said to be simple, as in practically all the *Leguminosæ* (peas and beans, &c.), and the *Proteaceæ* (Silky Oaks, &c.), *Lauraceæ* (Laurels).

If it consists of more than one carpel, as in oranges and other citrus fruits, it is said to be compound.

The compound form of pistil is much the commoner of the two referred to. It may consist of a number of carpels quite free or distinct from one another, as in the Buttercups, when it is termed apocarpous; or the carpels may be more or less united or joined together, as in Eucalypts, Tea Trees, Crow's Ash, &c., which state is termed syncarpous.

In the syncarpous pistil the carpels may be fused along their edges only, as in Passion-fruit (*Passiflora*), and the pistil is consequently only one-celled; or the margins of the carpels (carpellary leaves) may project inwards and unite in the centre of the pistil, as in *Eucalyptus*; the partitions thus formed are called dissepiments, and the parts into which they divide the ovary are called cells or loculi, and the ovary itself is termed multi-locular, or, more frequently, 2-, 3-, 4-celled, &c., according to the number of cells formed.

Occasionally the margins of the carpellary leaves unite and project for some distance inwards, but are not continued to the centre of the pistil, forming what is known as a chambered or imperfectly multilocular ovary; such a condition occurs in the Poppy (*Papaver*).

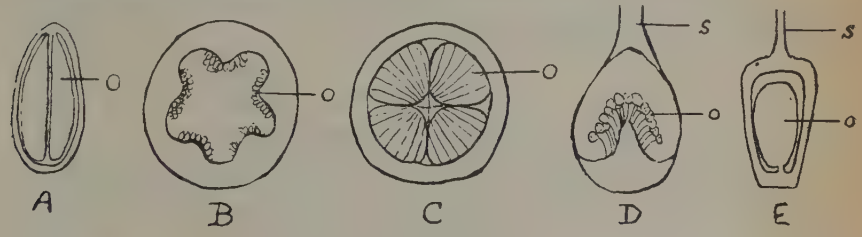


Plate 167.

PLACENTATION.

A. Parietal (sutural)—*Grevillea.*
B. Parietal—Papaw (*Carica*).
C. Axile—*Eucalyptus.*
D. Free Central—Pig Weed (*Portulaca*).
E. Basal—Sunflower (*Helianthus*).

[All figures diagrammatic; *o*, ovules; *s*, base of style.]

Placentation (Plate 167).—The portion of the ovary on which the ovules are borne is called the placenta, and the way in which the placentas are arranged in the ovary is called the placentation.

Rarely the ovules are developed over the whole of the inner walls of the ovary, as in the Water Lilies (*Nymphæa* spp.), the placentation in this case being termed superficial.

Usually the placentation is marginal, the ovules being borne on the margins of the carpellary leaves; of marginal placentation there are two well-marked forms—(*a*) Parietal, which occurs in the unilocular ovary, the adjacent united margins of the carpels forming so many placentas on the inner wall of the ovary; (*b*) axile, or axillary (Plate 167), which occurs in the multicellular ovary, the placentas occurring in the inner angle formed by the margins of the cell-wall. Sometimes the ovules are borne on a central axis, which is a prolongation of the torus into the ovary, which is free from the cell-wall, and is not connected with it by dissepiments; in this case the placentation is described as free-central. When the central axis is short the placentation is often spoken of as basal, but this term in a more limited sense is confined to cases where a single ovule is borne on the basal wall of the ovary, as in Daisies, Sunflower, and other plants of the large family *Compositæ*.

In the simple monocarpellary pistil, as in peas and beans, the placenta is formed on the ventral suture; and as it is borne on the inner wall of the ovary it is parietal, but is generally referred to as simply marginal or sutural. The true monocarpellary pistil can easily be told by the presence of this single placenta.

Style and Stigma.—The style is commonly a slender, cylindrical neck, but is sometimes flat, or even leafy and petaloid, as in the Iris; sometimes it is very short, appearing merely as a constriction between the ovary and stigma, or it may be absent, as in the Mangosteens (*Garcinia* spp.).

The stigma is usually terminal, rarely lateral. Its surface may be covered by small papillæ, or hairs, and secrete a sugary fluid by means of which the pollen grains adhere when they fall upon it.

Ovule.—The ovules appear as rounded outgrowths from the ovary. They may be sessile or attached to the placenta by a slender stalk—the funiculus or funicle. The point where the body of the ovule is attached to the funicle is termed the hilum, and is often seen as a prominent scar on the matured seed.

CHAPTER VII.

The Fruit and Seed.

The fruit is the result of the fertilization and development of the ovary, the process of which will be described in a later chapter.

After fertilization the pistil continues to develop, the other floral members, stamens, petals, &c., usually perishing and falling away, their work of protection to the younger parts of the flower, or the part taken by them in the fertilization of the ovary, having been finished.

Usually the fruit consists simply of the ripened ovary, containing a number of seeds—the ripened ovules. Sometimes, however, other parts of the flower go to form the mature fruit. To quote two instances, in the Strawberry the main fleshy portion consists of the enlarged floral receptacle which bears on its surface a number of small bodies, the ripened carpels. In Eucalyptus and allied trees the calyx-tube enlarges, becomes woody, and encloses the seed vessel. The Pome is a form of fruit restricted to the Apple, Pear, Quince, and a few allied

plants. It consists of five imperfectly fused carpels, forming what is popularly known as the "core," surrounded by a fleshy mass of tissue developed from the floral receptacle, which bears at its top the withered calyx of the flower. The "hip" of the rose consists of an enlarged calyx-tube (receptacle) enclosing a number of dry, one-seeded fruits.

The wall of the ovary in the matured fruit becomes the pericarp, which may be soft and fleshy, as in the Peach, Plum, &c., or hard and dry as in the Wooden Pear, Sida retusa, Sweet Pea, &c. Sometimes the pericarp is differentiated into three distinct layers—(*a*) The outermost layer or skin, the epicarp; (*b*) the middle layer or mesocarp; and (*c*) the inner layer or endocarp. These layers are well seen in such stone fruits as the Peach, Apricot, &c.

Fruits which, when ripe, open naturally to disperse their seeds are said to be dehiscent, and those which do not to be indehiscent.

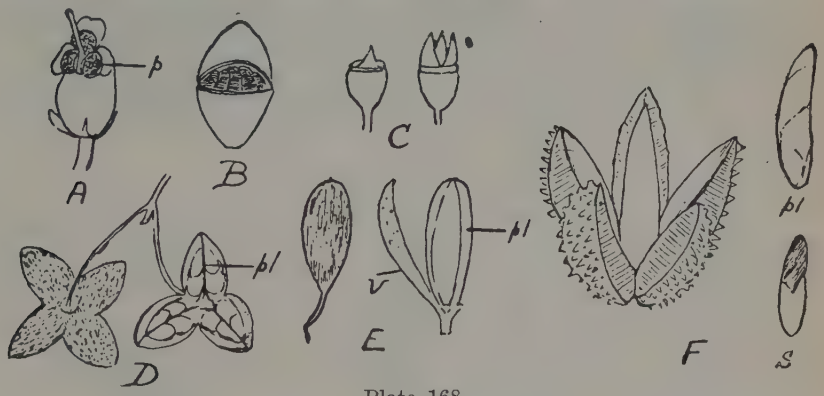


Plate 168.
Capsules and their Dehiscence.

A. By pores—Snapdragon (*Antirrhinum*).
B. Circumsciss—Pigweed (*Portulaca*).
C. By valves—*Eucalyptus.*
D. Loculicidal—Maiden's Blush (*Sloanea*).
E. Septifragal—Red Cedar (*Cedrela*); the five valves are thrown off, leaving the placentas in a column in the centre; one valve is shown in the diagram.
F. Septicidal—*Flindersia.*
p, Pore; *pl*, placenta; *s*, seed; *v*, capsule valve.

Dehiscence (Plate 168) may be through pores or slits in the pericarp, as in the Snapdragon (*Antirrhinum*) and Poppy. The pericarp may separate into two parts along a horizontal line, the upper portions falling away like a lid, as in Pigweed (*Portulaca*) and Pimpernel (*Anagallis*); occasionally the pericarp may burst irregularly, as in Red Ash (*Alphitonia*). Usually the pericarp splits along its whole length, as in simple fruits like the pea, bean, and allied plants, Silky Oak, Kurrajong, Bottle Tree, &c.

In multilocular fruits the pericarp may split down (1) along the middle of the carpels, breaking up into a number of valves with the placenta or septa running down the centre of each, as in *Jagera* (Foam Bark), *Pittosporum, Celastrus, Sloanea* (Maiden's Blush, Yellow Carrabin), &c.; (2) along the dissepiments, the placentas separating in the middle, as in *Flindersia* (Crow's Ash or Teak, Cudgerie), &c.; (3)

longitudinally into a number of valves, but the placentas and seeds are left in the middle, as in the Red Cedar (*Cedrela*), in the Thorn Apple or Stramonium (*Datura*), Silk Cotton Tree (*Bombax*), &c.

There are a great number of terms applied to different types of fruits. In many cases the peculiar fruits of certain families of plants have distinctive terms applied to them.

Principal Types of Succulent Fruits.—The Drupe (Plate 169, fig. C)—In this the pericarp is differentiated into three distinct layers of (*a*) epicarp, (*b*) mesocarp, and (*c*) endocarp. The mesocarp is generally succulent and fleshy, the epicarp forming a comparatively thin outer rind or skin. The endocarp is either cartilaginous (of the consistence of parchment), or hard and woody, when it is commonly termed a stone, and the drupe referred to as a stone-fruit, as the Peach, Plum, Apricot, &c.

The mesocarp is not always thick and fleshy. Sometimes it is thin and scanty, as in some wild fruits, for instance, different species of Quandong, Deep Yellow-wood or Yellow Cedar (*Rhodosphæra*), &c. In the Coconut (*Cocos nucifera*), the mesocarp is fibrous and the fruit is sometimes called a fibrous drupe. In the allied Wine Palms (or *Butia capitata* and its varieties) the mesocarp is more succulent and edible.

The Berry (Plate 169, fig. A) is a fruit in which the mesocarp is succulent, and the seeds are immersed in the pulp. The seeds are not enclosed in a hard putamen, and in this it differs essentially from the drupe. Familiar cultivated or naturalised plants with typical berry fruits are the Grape, English Gooseberry, Cape Gooseberry, Tomato, Passion Fruit, Custard Apple, and Prickly-pear.

The Chili or Capsicum is an example of a dry berry, the succulent tissue drying up as the fruit ripens. In the nutmegs (*Myristica*) the pericarp dehisces.

The fruit of the Orange, Lemon, &c., is a form of berry which has received the distinctive term of hesperidium; the outer skin or rind is the epicarp, the inner white substance the mesocarp, and the thin membrane lining the loculi or cells the endocarp.

The Date may be recognised as a berry on account of the absence of a hard putamen. The outer skin is the epicarp, the fleshy, sweet part of the fruit the mesocarp, and the endocarp is a very thin, membraneous layer surrounding the hard seed.

Principal Types of Dry and Dehiscent Fruits.—Follicle (Plate 169, fig. E) consists of a single carpel and dehisces along one suture only. Examples: Silky Oak, Flame Tree, Bottle Tree, Kurrajong, Milky Pine, Native Cinchona (*Alstonia* spp.), Milky Cotton, &c.

Legume (Plate 169, fig. F) typically consists of one carpel, and dehisces along both sutures. It is the typical fruit of plants of the Order *Leguminosæ*, pea and bean family, to which the term is confined.

The siliqua is a long and the silicule a short, dry fruit opening in two valves from below upwards. They are the characteristic fruits of the *Cruciferæ* (Cabbage, Turnip, Wallflower, &c.). In separating, the valves leave their margins, and the margins and placentas are left behind, with a membranous partition stretched between them and against which the seeds lie.

We often find in descriptive works that the terms legume, siliqua, and silicule are rarely used, all forms going under the comprehensive term of pod.



Plate 169.

FRUITS OF SOME FOREST TREES.

A. Berry of *Capparis Mitchellii* (Bumbil Tree, Wild Orange, or Native Pomegranate;

B. Transverse section of same, showing numerous seeds embedded in soft pulp.

C. Drupe of *Elæocarpus grandis* (Blue Quandong or Caloon);

D. Putamen of same.

E. Follicle of Kurrajong (*Brachychiton populneum*).

F. Face and side view of legume (pod) of a Wattle; notice that it dehisces along both sutures.

G. Samara of *Tarrietia Argyrodendron* (Booyong, Crow's Foot Elm or Stavewood).

H. Nut (acorn) of *Quercus Cerris* (Turkey Oak); *c*, cupule, composed of fused woody bracts.

(All the above, with the exception of H., are natives of Eastern Australia.)

[*Photo., Department of Agriculture and Stock, Brisbane, from "Elementary Text-book of Australian Forest Botany."*]

The capsule (Plate 168) is a dry, usually syncarpous fruit which opens and sheds its seeds either in two or more longitudinal slits for its whole length (as in *Flindersia*) by valves at the top (as in *Eucalyptus*), or by pores or small openings in the pericarp (as in the Poppy, *Papaver,* and Snapdragon, *Antirrhinum*).

The capsule is almost universally a dry fruit, but occasionally, as in the Wood Sorrel (*Oxalis*), may be somewhat fleshy. Occasionally it is rather difficult to know exactly whether a fruit should be termed a rather fleshy capsule or a rather dry berry, as in the Blue Tongue (*Melastoma malabathricum*), a very common shrub in coastal swamps, which might be termed a fleshy capsule opening irregularly.

Dry and Indehiscent Fruits.—Nut (Plate 169, fig. 8), a one-seeded fruit with a hard, dry pericarp. A few familiar examples are the "Hazel" or "Barcelona" Nut (*Corylus avellana*), the acorns of the Oak (*Quercus*), and the Spanish Chestnut (*Castanea sativa*). Usually the nut is surrounded by a cupule formed by bracts. In the Hazel Nut they are thin and dry, in the Oak they are united together to form a cup or cupule; in the Chestnut two nuts are enclosed in a spiny cupule.

The examples given above are true examples of nuts as the term is understood in the botanical sense. In a popular and commercial sense the word has a much wider use; thus the Walnut and Almond, as presented for sale, are only parts of a drupaceous fruit, Brazil Nuts, the seeds from the large capsule of a South American tree (*Lecythis* sp.).

The term nutlet is one commonly applied to any small, dry, indehiscent fruit.

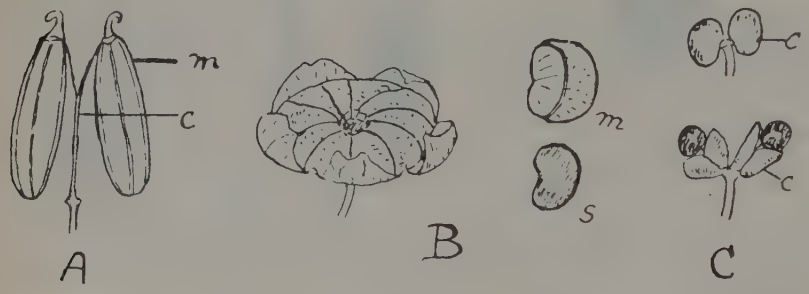


Plate 170.

SCHIZOCARPIC FRUITS.

A. Cremocarp of Fennel (*Fœniculum*); *c*, carpophore; *m*, mericarp.
B. Carcerulus of Mallow (*Malva*); *m*, a single mericarp; *s*, seed.
C. Regma of Wilga (*Geijera*); *c*, cocci.

Samara (Plate 169, fig. G), any dry, indehiscent fruit provided with a membrane or wing developed from the pericarp—e.g., White Bean and Tree of Heaven (*Ailanthus*), *Ventilago* (Supple Jack), Elm (*Ulmus*), Crow's Foot Elm (*Tarrietia*), &c.

Sometimes a fruit may simulate a samara by parts of the perianth developing into wings, thus in *Gyrocarpus Jacquini*, a common soft-wooded tree found round the coasts of North Queensland, two of the

calyx lobes are developed into comparatively big upright wings. In *Terminalia*, a genus of trees common in North Queensland, the drupes of some species may have the pericarp flattened into prominent wings, sometimes into a prominent wing surrounding the whole drupe; there is, however, a gradual transition among the species from the ordinary fleshy drupe to this winged form. True samaræ, also, must not be confused with winged seeds such as those of the Teak or Crow's Ash, Silky Oak, Wheel of Fire, &c.

Some fruits, when ripe, split into a number of one-seeded, usually indehiscent carpels. When indehiscent, resembling achenes, the individual carpels are termed mericarps, as in plants of the large family *Uumbelliferæ* (Carrot, Parsley, Parsnip, Celery, &c.), (Plate 170, figs. A and B). These mericarps are popularly called "seeds," as in Caraway, Dill, &c., and in sowing plants belonging to the family *Umbelliferæ* it is the mericarps which are sown. Each mericarp contains a seed. When dehiscent the individual carpels are termed cocci, as in the Castor Oil, Cape Chestnut, Wilga, &c. (Plate 170, fig. C).

Syncarps or Composite Fruits.—These are not very common. They are the result of a whole inflorescence, sometimes of several, sometimes of very many individual flowers, not of a single flower, as in the forms previously described. Descriptions of the more familiar examples are here given:—

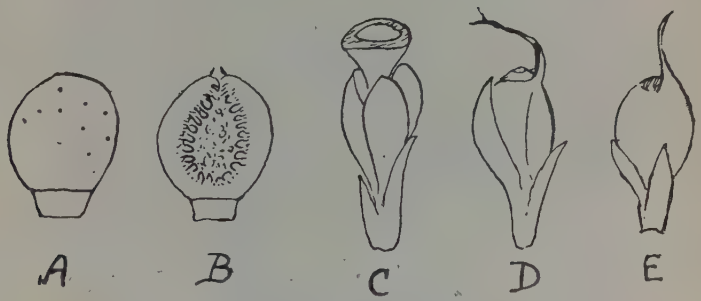


Plate 171.

Structure of Fruit of a Fig (*Ficus rubiginosa*)—Port Jackson Fig (adapted from illustration in Maiden's "Forest Flora of New South Wales").

A. The Fig. B. Section of same. C. Male. D. Female. E. Gall-flower. A and B, natural size; C, D, and E, much enlarged.

(1) Fig (Plate 171).—The flowers are minute, and are borne closely packed on the inner wall of the receptacle. The ovaries of the female flowers develop into achenes, which are popularly regarded as the seeds.

(2) Pineapple and Mulberry.—The flowers are borne in a spike. In the pineapple the fleshy axis and the individual flowers all fuse together. The axis is continued, and bears a crown of leaves at the top. In the Pineapple seeds are rarely produced on cultivated plants, reproduction being performed by means of "suckers" and "crowns." In the Mulberry the male and female flowers are borne in separate spikes. The perianths of the female flowers become fleshy, and enclose the carpels.



Plate 172.

CONE OF MACROZAMIA DOUGLASII (a coastal species of Zamia Burrawang or Wild Pineapple).

(3) Cone (Plate 172).—This is the typical fruit of members of the Coniferæ or Pine family, and of most of the *Cycadaceæ* or Cycads (*Macrozamia*, &c.). The male and female flowers form distinct spikes. The female bears a number of scales along its axis, at the base of which on the upper surface one or more seeds are developed, as in the Pines (*Pinus*), or a seed may be enclosed in each scale, as in *Araucaria* (Hoop Pine, &c.).

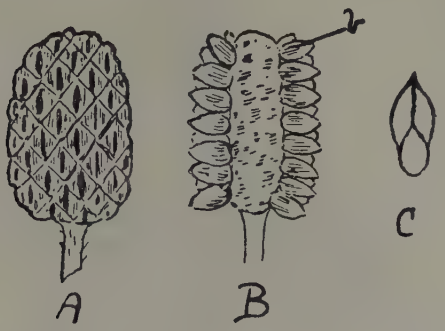


Plate 173.

A. Typical cone of a She-oak (*Casuarina*).
B. Longitudinal section of same, showing the numerous woody bracts (*b*).
C. A single samara.

(4) In the She-oaks (Plate 173), it is the fused, woody bracts which form the "cones." They open as valves at the top when ripe, and shed the samaræ or winged achenes popularly regarded as seeds. These little samaræ are compressed, a shining brown, and produced at one end into a membranous wing, which aids in their distribution.

(5) In *Syncarpia*, a genus of few species, the best known of which is the Turpentine (*Syncarpia laurifolia*), the inflorescence is a head. The calyx tubes of the individual flowers are fused in their lower portions, and when ripe the inflorescence develops into a dense head of woody capsules.

(6) In some species of *Pandanus* (Screw Pine) (Plate 174) several drupes are joined together to form a syncarp; the syncarps are borne in a large head or spike, are tightly packed together, but fall off singly when ripe.

Seeds.

After fertilization of the ovary the ovules develop into seeds, and it is on the production of fertile seed that the continuance of a species depends. In a few cases, such as the Banana and Pineapple, fertile seed is rarely produced in the cultivated races, reproduction being by suckers or other vegetative means.

The seed is distinguished by the fact that it contains an embryo, or rudimentary plant. Normally only one embryo is developed within a seed, but occasionally more than one may be formed. This is frequently seen in the Mango (*Mangifera indica*).



Plate 174.

Fruiting head of Pandanus. It is composed of numerous syncarps, each syncarp composed in its turn of six to eight drupes.

In the embryo can be distinguished three main parts—(*a*) the radicle, from which the primary root of the plant will be developed; (*b*) situated above it, one or more minute leaves—the cotyledons; and (*c*) above them, forming the tip of the embryo is the plumule, or embryonic shoot, which develops into the primary stem.

The Angiosperms (see Chapter I.) are divided into two great groups, the Dicotyledons and Monocotyledons, respectively. The former contains most of our fruit trees, and in this group the embryo typically possesses two opposite cotyledons or seedling leaves. The latter group contains such plants as the grasses, lilies, bamboos, palms, &c. The embryo contains only one cotyledon.

In many Gymnosperms (conifers, &c.), and occasionally in some Angiosperms, more than two cotyledons are developed in an embryo.

The outer covering of the seed or seed-coat is termed the testa. It varies considerably in texture and colour in different species, and its characters are useful features to note in plant descriptions. The colour is a useful guide in identifying the many varieties or races of such cultivated plants as the Cowpeas or Lima Beans. It is sometimes beautifully marked, especially in small seeds, with raised lines, points or tubercles, pits, &c. A study of the colour, markings, &c. of different commercial seeds and their adulterants, of weed seeds, and so on, is of inestimable value to the agriculturist, forester, or others interested one way or another in plant life. The testa may be winged, either all round or at both ends, as in some species of *Flindersia* (e.g., the Cudgerie, *F. Schottiana*), or at one end only, as in some other species of *Flindersia* (e.g., the Crow's Ash, *F. australis*). It may bear a tuft of hairs at one end, as in the Wild or Cape Cotton (*Aselepias*), or it may be completely clothed with hairs, which may be long, as in the Cotton (*Gossypium*), very short, or long at the ends only, as in *Alstonia* (Bitter Bark and Milky Pine).

Sometimes the testa is hard and enamel-like, the seed requiring special conditions to aid germination. This is sometimes accomplished by fire charring or cracking the seed coat, making it permeable to water. A familiar example is the way in which various species of Wattles or *Acacia* spring up in an area after the country has been cleared and a fire put through it. This is particularly noticeable in the "scrub" or "brush" areas of North-Eastern New South Wales and coastal Queensland, where, perhaps, after clearing and burning the country, "Sally" Wattles will spring up in thousands, although in the standing "scrub" only an occasional individual tree will be noticed. Other examples are the Red Ash and Sarsaparilla trees (*Alphitonia* spp.), which come up in the same way. Seeds provided with a hard testa usually retain their vitality for a considerable time, and may germinate when suitable conditions occur, even after a lapse of over fifty years. Most testas are comparatively thin, but in the Australian Bush Nut (*Macadamia*) it is thick and woody.

Sometimes, as the seed develops, a further covering, termed an aril or arillus (Plate 175) grows over the testa, and may partly or wholly enclose the seed. It is very well developed in plants of several orders. In the Litchi and Longan, largely exported as dried fruits from China,

it is the aril which provides the edible part of the fruit. It is the aril, also, which is the very tart, edible portion of the different species of so-called Native Tamarinds (various *Sapindaceæ*). In the Nutmegs (*Myristica* spp.) it forms a beautifully lobed, red, outer covering to the aromatic seed, and is known as the "mace," and it is the red portion of the African Lucky Bean (*Afzelia africana*), the seeds of which are often to be seen used in various ways for ornamental purposes. The aril is usually developed from the funicle.

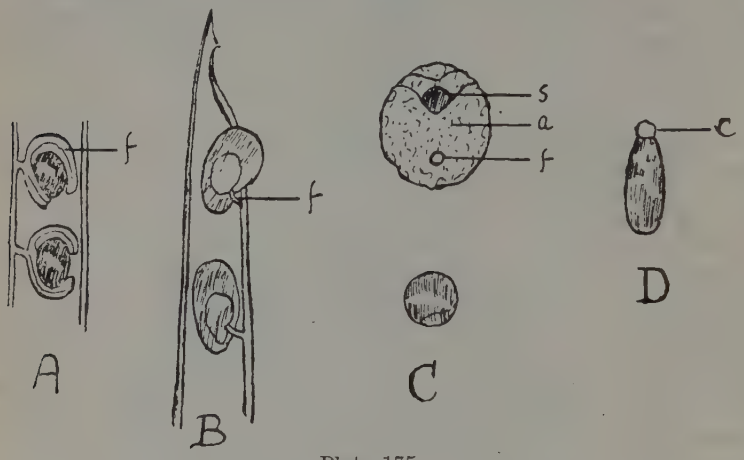


Plate 175.

FUNICLE, ARILLUS, AND STROPHIOLE.

A. Seeds of Yarran (*Acacia homalophylla*); the funicle (*f*) is long and folded round the sed.

B. Seeds of Gidgee (*Acacia Cambagei*); the funicle is short.

C. Seed of *Nephelium* (*Arytera*) *tomentosum*, above enclosed and below free from the arillus; *s*, seed; *a*, bright-red arillus; *f*, base of the funicle.

D. Seed of Wedding Bush (*Ricinocarpus pinifolius*); *c*, caruncle or strophiole.

[A and B adapted from illustrations in Maiden's "Forest Flora of New South Wales."]

Sometimes an outgrowth, similar to an aril, but smaller and localised, is formed. This is termed a caruncle or strophiole. It is seen in the Castor Oil (*Ricinus*) and many other plants of the family *Euphorbiaceæ*.

The hilum is the scar left on the seed at its place of attachment to its stalk or funicle. It is very prominent in some of the larger-seeded legumes.

Enclosed within the seed-coat is what is popularly known as the kernel. In some cases it consists of the embryo alone, in which case the cotyledons are comparatively large, or the embryo may occupy only a small part of it, the remainder of the seed in which the seed is more or less embedded being known as the albumen. Seeds in which albumen is present are known as albuminous, and those in which it is absent exalbuminous. This is an important fact to note, and one which is almost always referred to in plant descriptions. The Peach, Plum, and Almond are examples of albuminous seeds, and peas and beans of exalbuminous seeds, respectively. Examples of albuminous and exalbuminous seeds are shown in Plate 176.

The embryo and the albumen in which it is embedded are often rather difficult to distinguish, and can only be readily made out when the seed is quite ripe, or more easily during the process of germination.

The albumen varies considerably in character. It may be mealy (when it is easily broken into powder), spongy, oily (as in the Castor Oil, Tung Oil, Candle Nut), fleshy, or even hard and bony (as in the Ivory Nut).

When the albumen is puckered into narrow folds, as in the Nutmeg (*Myristica*), Bangalow or Picabeen Palm (*Archontophœnix*), &c., it is said to be ruminate.

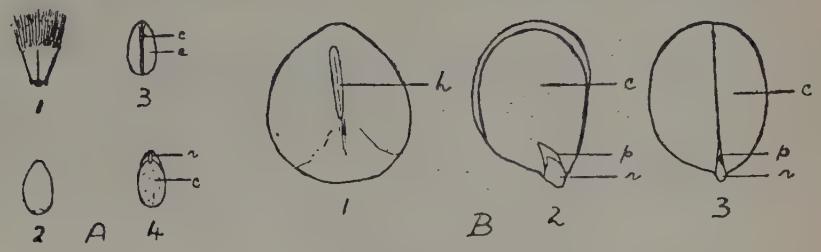


Plate 176.

Seeds.

A. Albuminous seed of Kurrajong (*Brachychiton populneum*).
1. Seed enclosed in its hairy outer testa.
2. Seed with outer testa removed.
3. Longitudinal section of seed vertical to the cotyledons.
4. Longitudinal section parallel with the cotyledons.

B. Exalbuminous seed of Black Bean (*Castanospermum*).
1. Seed.
2. Longitudinal section parallel with the cotyledons.
3. Longitudinal section vertical to the cotyledons.

a, Albumen or endosperm; *c*, cotyledon; *h*, hilum; *p*, plumule; *r*, radicle.

On germination taking place the cotyledons may remain under the ground, as in the Peach, common garden Pea, Bean Tree, &c., when they are said to be hypogæal, or may be raised up on the growing stem above the ground level, when they are said to be epigæal, as in the French Bean, Wattles, Eucalypts, &c.

The portion of the stem of a young seedling below the insertion of the cotyledons is termed the hypocotyl. That part lying between the insertion of the cotyledons and the first foliage leaf or leaves is termed the epicotyl.

The functions of the cotyledons are various. In albuminous seeds they absorb the nutritive matters in the albumen and transfer them to the growing plant; in exalbuminous seeds, where they are epigæal, as in Eucalypts, Wattles, French Bean, &c., they form the first seedling leaves of the plant; on the other hand, where they are hypogæal, as in the Peach, common garden Pea, &c., they simply act as a storehouse of reserve food materials for the young plant to draw upon.

CHAPTER VIII.

Clothing of Plants.

A large number of terms are used in describing the clothing of the surface of plant members with hairs or wax. If quite devoid of hairs or bristles, as the Poinciana, the leaves of most Eucalypts, &c., a plant is said to be glabrous.

The young parts of plants are almost always much more densely clothed with hairs than the older ones, and in many cases where the young parts are more or less densely clothed with hairs the older parts are glabrous, or nearly so, the hairs acting as a protection to the young, tender leaves.

Glands.—The term gland is one used in a very wide sense in descriptive botany, being applied to several epidermal productions. They may be—

1. Small, fleshy, wart-like bodies, occasionally secreting small quantities of oily or resinous matter but more frequently dry. They commonly occur on the leaves and phyllodes of wattles, and their position and relative size are usually found noted in descriptions of the different species. They occur on the petiole and leaf rhachis of many species of Cassia and many pinnate-leaved Wattles, and their position and relative number serve as a useful character in differentiating the different species. They commonly occur on the leaf-stalks or at the bases of leaves in plants of the families *Euphorbiaceæ* (e.g., Candle Nut) and *Passifloraceæ* (Passion-fruit, &c.).

2. Small raised dots or streaks, usually dark coloured, but sometimes paler, and may occur on any part of the plant. They are very abundant on the under surface of the leaves of different species of *Mallotus*. In *M. philippinensis* they are red; in *M. discolor*, yellow. These two species, particularly the former, are comparatively common in Queensland, and the colour of the glands forms a useful character for differentiating the species when leaves only are available.

In the same genus glands may be abundantly produced on the stems, leaves, &c., of one species, and be entirely absent in another—e.g., the under surfaces of the leaves of *Vitex acuminata* are profusely glandular-dotted, whereas in the *Lignum vitæ* (*Vitex lignum-vitæ*) they are not.

3. Small dots or streaks full of oil embedded in the substance of different plant members. If a leaf of a Eucalypt or Tea Tree be held up so that the light strikes through it oil dots are generally plainly visible to the naked eye, and in all cases except where the leaves are very thick they are easily observable with the aid of a low-power magnifying lens.

The presence of oil dots in the leaves is characteristic of all plants of the large families of *Myrtaceæ* (Gums, Tea Trees, &c.) and *Rutaceæ* (Citrus family).

In the family *Umbelliferæ* they occur in the pericarp, and the oil they contain gives to such fruits as Carraway, Dill, Fennel, Aniseed, &c., their characteristic odour and taste. They are generally conspicuous, and can be readily seen on transverse section of the fruit.

4. The term "gland" is also applied to the lobes of the disk, and to other small, fleshy, protuberances within the flower developed on any of the floral members.

In the flowers of most *Proteaceæ* (Silky Oak family) glands (nectaries) are developed at the base of the pistil, and are termed hypogynous glands. They are secreting organs, and their form and characteristics are usually noted in descriptive work. In the Macadamia Nut they are united in a ring; in the Silky Oak (*Grevillea robusta*) in a semi-circle to one side of the pistil; in the Beef or Monkey Nut (*Hicksbeachia*) they are developed as four distinct lobes; in

Lomatia they form three or four unequal little knobs; in *Stenocarpus* they are very small or absent altogether; in the Native Honeysuckle (*Banksia*) they are scale-like.

Foveolæ and Domatia.—Very often on the under surface of leaves in the axils of the nerves, and usually of the midrib and main laterals, small pits or depressions or tufts of hairs will be observed. These are called foveolæ or domatia. They are often inhabited by minute insects or mites, which, as a general rule, apparently, have no harmful effects on the plant.

Accessory Organs.—Under the broad heading of accessory organs various external parts of plants, such as hairs, scales, thorns, prickles, &c., may be conveniently discussed.

Most of the growths here dealt with are various appendages occurring on the root, stem, or leaves, and may be described under the headings of (*a*) Hairs, and (*b*) Emergences.

Hairs.—Hairs are always developed from superficial cells, and vary considerably in form and structure. They may be simple or branched. When the branches radiate out horizontally the hairs are said to be stellate, as those on the coppice shoots of the White Stringybark (*Eucalyptus eugenioides*), on the flowers and young growth of the Kurrajong, on the leaves of the Wild Tobacco and other species of *Solanum,* &c. Sometimes the stellate hairs have their individual rays united in the lower parts, forming little flat, circular discs attached at the centre to the epidermis. They are then called scales, and the surface is said to be scaly or lepidote—e.g., the under surface of the leaves of the trees variously called Booyong, Stave Wood, Crow's Foot Elm or Hickory (*Tarrietia argyrodendron* and its varieties), of the Native Cascarilla Bark (*Croton insularis*), &c.

In the species of *Urtica* (Stinging Nettles) and *Laportea* (Stinging Trees) the surface is covered with stinging hairs of a peculiar structure, and containing a strong acid. The hairs arise from a basal cushion, and taper gradually to the apex, where they are terminated by a small head, which breaks off at the lightest touch, and the hairs piercing the skin pour out a strong acid, producing the well-known irritating effects.

Hairs often vary in structure, not only on the same plant, but on the same member. The Nettles and Stinging Trees just referred to possess, in addition to the stinging hairs, a great many more smaller, non-stinging hairs scattered all over the branchlets and leaf surfaces. On the leaves of some species of *Solanum* simple and stellate hairs may both occur. Sometimes hairs are terminated by a little rounded cell or cells secreting oil, gum, or resin, often strongly scented and giving the plant a sticky, viscid surface—e.g., the Tobaccos (*Nicotiana* spp.).

Emergences.—These differ from hairs in not being solely provided from superficial cells, but from others lying beneath them. They may occur as prickles—e.g., on stems of roses and brambles, species of *Solanum* (Devil's Needle, Devil's Apple, &c.); as glands or warts—e.g., on leaves and phyllodes of Wattles, as outgrowths from the foliage or floral leaf, as the corona of Narcissus; other more complex forms are the tentacles formed on the leaves of Sundews (*Drosera* sp.), the suckers or haustoria formed on the stems or roots of parasitic plants, such as the Dodders (*Cuscuta*), Dodder Laurels (*Cassytha*), &c.

Some botanists clearly differentiate the terms thorn, spine, and prickle. Others class the first two together. Strictly speaking, thorns are modified branches, and, in consequence, develop from the leaf axils, either where leaves are present, or where they would normally be developed—e.g., the Cockspur Thorn (*Cudrania*), Bougainvillea, Citrus, &c. Spines are modified leaves or parts of leaves, as in the Prickly or Mimosa Bush (*Acacia farnesiana*), where the stipules are so modified, and in some Thistles, where the lobes of the leaf terminate in sharp spines. Prickles are sharply pointed outgrowths of the epidermis, and may occur practically on any part of the surface. Thus, in many species of *Solanum* (e.g., Devil's Apples, *Solanum aculeatissimum* and *S. sodomæum*) they occur not only on the stem but on the leaves and calyces. Prickles are developed from more or less superficial tissues, and if the bark be stripped they come away with it—e.g., the Devil's Needle and Devil's Apple (*Solanum* spp.), the native and other Raspberries and Blackberries (*Rubus* spp.), the common garden Rose, &c. Thorns, spines, and prickles generally serve the purpose of either helping the plant in climbing, as in the Cockspur Thorn (*Cudrania*), Lawyer Cane (*Calamus*), &c., or act as a protection against the attacks of herbivorous animals, and, in consequence, are rarely found on large trees.

Many trees, however, are thorny or spiny in their young stages, but quite unarmed when older. In the young state some trees such as the Desert Lime (*Eremocitrus*) and Leopard Wood (*Flindersia maculosa*) present masses of tangled branches bearing very few leaves, and with each branchlet ending in a thorn; when at a height of 4 or 5 feet a leading shoot grows up into a small tree, the lower part of the stem continuing to bear a mass of thorny branches. The upper branches are quite unarmed, and as the trees increase in age and size these lower branches are shed until the trunk presents a smooth appearance, bearing a head consisting of a number of unarmed leafy branches.

CHAPTER IX.

Habit.

The general appearance of a growing plant is called its habit. This depends largely on the character of the stem, whether erect or ascending, prostrate, &c., its mode of branching, and so on.

A shrub differs from a tree in its smaller size and generally in habit of growth, shrubs usually branching out from near the base. Sometimes plants that occur as shrubs in some localities attain tree size in others. In some plants such as certain Eucalypts in Western Australia there is a tree form and shrub (mallee) form of the same species.

Plants in which the aerial stem is more or less succulent or herbaceous, and dies down annually—as in most of the common farm and garden weeds—are called herbs. Sometimes, though dying down annually, the stems are more or less woody and the plants large and shrub-like in appearance, as in the Sesbania Pea (*Sesbania aculeata*). Such plants are said to be shrubby.

An undershrub is a plant part of the stem of which persists for more than one year. Examples are the Wild Senna or Yellow Pea (*Cassia Sophera*), *Sida retusa*, &c.

The basal portion of an undershrub, or the thick, woody basal part of the stem of an herbaceous perennial lying at or just below the surface of the soil, and partly formed by the lower portion of the stem and the upper thickened woody portion of the roots, is termed the stock. In many plants the stock often attains a considerable size, forming large, woody masses just below the surface of the soil. This is particularly noticeable in Australian plants of the poor, sandy country, typical of a lot of our coast lands, and covered with such peculiarly Australian genera as *Banksia, Lomatia, Gompholobium, Boronia, Ricinocarpus,* &c. Bush fires run through this country during the more or less regular dry seasons, but after suitable rains the old stocks send out numerous new vigorous stems.

In horticultural practice the term stock is applied in grafting or budding to the plant on which the grafting is done; the part inserted into the stock is called the scion.

Plants, or parts of plants, are described as annuals, if living only for one year; biennial, if living for two; perennial if persisting longer.

Plants which are found growing thickly together, forming at times almost pure stands, are said to be gregarious. Examples in Queensland are Mulga (*Acacia aneura*), Brigalow (*Acacia harpophylla*), the Beelah (*Casuarina leptodophloia*), White Cypress (*Callitris glauca*), and Paper-barked Tea Trees (*Melaleuca* spp.). A plant the individuals of which are widely scattered the one from the other is said to be sporadic, as in most trees of the rich "scrub" or mixed forests of coastal Queensland and New South Wales.

Duration of Parts.—Many of the trees of older countries periodically completely shed their leaves, so that during the resting or winter months they are entirely bare of foliage. Such trees are called deciduous.

In Australia there are few native trees that can definitely be termed deciduous. The Flame Tree (*Brachychiton acerifolium*), commonly, though not always, is completely bare of green foliage when in full flower. The Red Cedar (*Cedrela*) and the White Cedar (*Melia*) are at times practically bare of foliage, but the time elapsing between the shedding of the old leaves and the unfolding of the new buds is very short.

Trees which bear green foliage throughout the year are termed evergreen.

[TO BE CONTINUED.]

EXTENSION SERVICE FOR THE FARMER.

If you want actually to study some subject or other, you can have courses of lectures posted to you from the Department of Tutorial Classes. The latest addition to the services given by this valuable Department is an undertaking to reply by post to questions on international subjects. Of course, this service is available only to those who join either for the library or for the lecture courses, 18s. 6d. and 8s. 6d. a year respectively.

If you want something worth while reading, or if you want to inquire further concerning the services available for country people, then write to-day to the Director of the Department of Tutorial Classes, corner Edward and Ann streets, Brisbane.



H. J. FREEMAN, Senior Instructor in Fruit Culture.

[*Continued from page* 501, *May*, 1936.]

The Packing House.

THIS is a most important factor in date growing. Individual effort by each grower on his own area is most unsatisfactory, for the simple reason that he cannot afford to erect a plant that would handle his output as effectively as a larger plant owned and run on a co-operative basis. It is fully realised that the growing and marketing of dates will become more specialised as the industry develops. In other parts of the world specially designed packing houses have had to be erected and operated by trained staffs, such being necessary in order to keep handling costs low and to place a high-quality product on the market. It is sincerely hoped that Queensland will reach this stage some day, but until then owners of small date acreages will find it most advantageous to handle this fruit through a co-operatively owned packing plant.

The situation of this packing house is also a very important matter. Firstly, it should be as near as possible to the areas upon which the dates are growing; and then transport by rail and road must be considered. The labour required in such a packing house would be of an intermittent nature, and in the main girls would be more suitable than men; so this fact should also be taken into consideration when choosing the packing house site.

In constructing a date-packing plant the house should be built as nearly insect-proof as possible, with all outside openings screened with wire gauze of not less than No. 36 mesh. The interior of the house should be divided into at least five well-isolated rooms, namely, receiving room, fumigating room, cleaning and grading room, ripening room, and packing room.

Fruit should be delivered to the receiving room in shallow, hardware, cloth-bottomed trays, and later placed in the fumigating room. After being fumigated the fruit is taken into the cleaning and grading room. Here the fruit is passed through the cleaners and on to the grading belts, where it is graded for marketable fruit and degree of ripeness. After grading the fruit is placed in ripening trays and conveyed to the

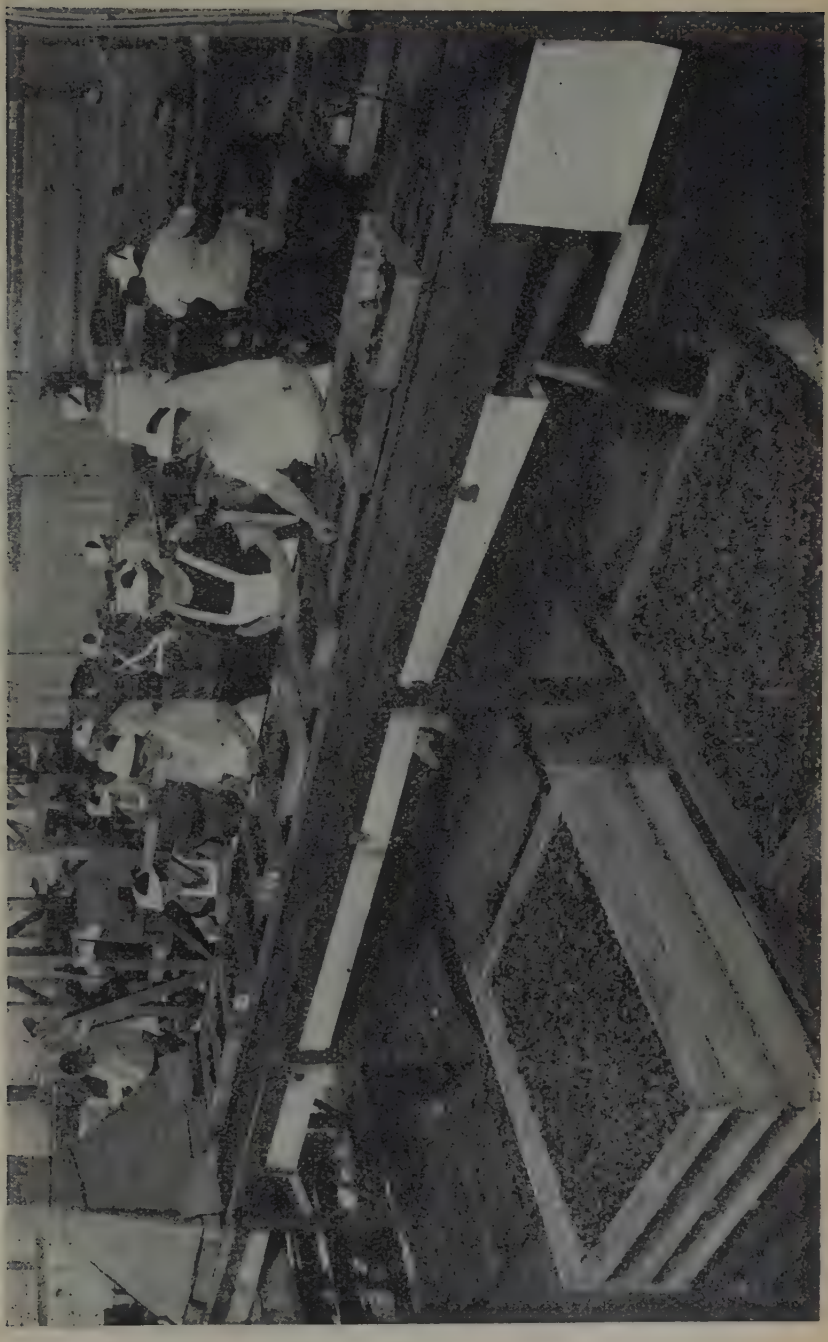


Plate 177.
Packing house "hands" grading and packing dates in Southern California.



Plate 178.
General view of interior of date packing house, Southern California.

ripening room, where maturation is completed under conditions of controlled temperature and humidity. After the fruit has reached the desired degree of ripeness and moisture content it is removed to the packing room, where it is regraded and packed.

Fumigation.

When handling dates commercially fumigation of the fruit is essential, for, even with the most rigid system of hygiene, immediate destruction of over-ripe and soured fruit, &c., some insects are bound to enter the packing house as the fruit is brought in from the groves. Damage and loss due to such insects can definitely be prevented by fumigating the fruit prior to its entering the packing room.

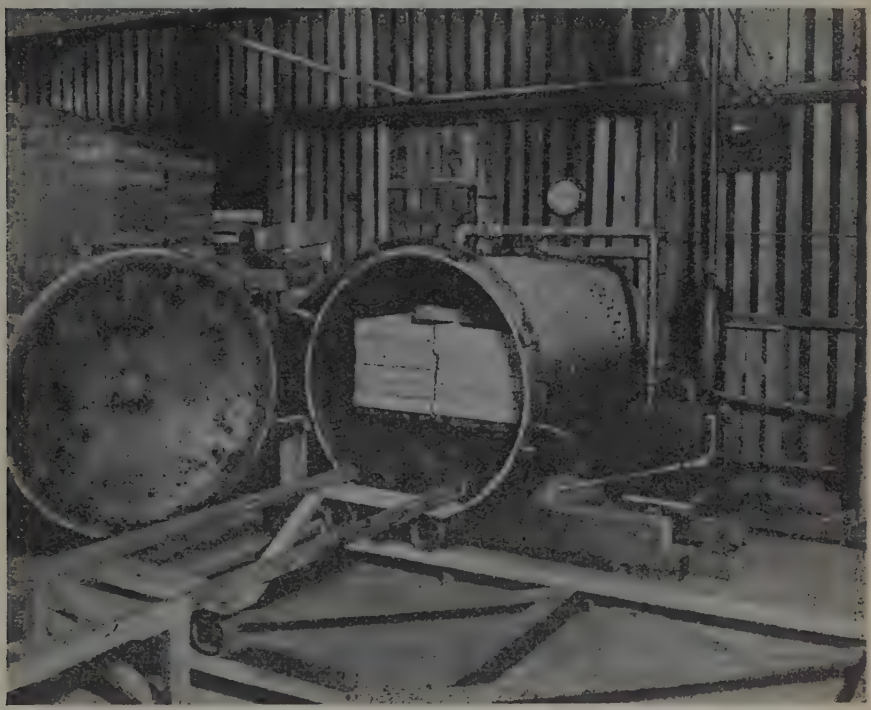


Plate 179.

California dates are now being packed in a modern plant at El Monte, owned by the Valley Packing Association, Inc., an organization of Coachella Valley date growers. Dates, fresh from desert palms, are here seen passing through a vacuum fumigator, which destroys all possible insect life.

In America a number of chemical fumigants have been used during the past ten years. Carbon disulphide, cyanide, and a mixture of carbon disulphide and carbon dioxide have given effective control, but their use has now been discontinued because of the dangers involved in handling. More recently a gas sold in America under the trade name of "Carboxide" has come into general favour, chiefly because it is non-explosive and non-poisonous to human beings. One of the disadvantages of using this gas, however, is the long period of exposure required for effective control of insects, viz., fifteen hours, but until something more

satisfactory is found the use of this gas is recommended. "Carboxide" consists of a mixture of ethylene oxide and carbon dioxide in the ratio of 9 to 1.

It is claimed that effective insect control can be obtained by subjecting the fruit to a temperature of 140 deg. Fahr. for two or three hours before it is removed from the ripening room. Unfortunately, this extreme temperature darkens the fruit, breaks down the juice cells, resulting in syrup exudation, and is deleterious to flavour and quality. For these reasons high temperatures cannot be recommended except in cases where fumigation facilities are not available.



Plate 180.

Because unprocessed dates are subject to souring, fermentation and surface moulds, their moisture content is lowered in dehydrators that are under both temperature and humidity control. The time required for a lot is found by laboratory test.

Cleaning the Fruit.

Fruit ripening on the palms gathers dust and other foreign particles which should be completely removed before placing in the maturation room. Several methods of cleaning the fruit have been devised.

Semi-soft varieties such as the Deglet Noor are cleaned in a revolving cylinder lined with brushes through which a strong current of air is drawn by a suction fan. The current of air carries away the dust and dirt as it is removed from the fruit by the brushes.

Soft varieties, such as Maktoom, are either washed by means of a water spray or cleaned by rolling the fruit over dampened towelling by means of a mechanical shaker. The latter method is recommended by American growers, as it cleans the fruit more thoroughly, and any damage by the excessive absorption of water is avoided. If dates are washed by immersion or spraying all water adhering to the fruit must be removed immediately, which is easily accomplished by passing the fruit through a blast of warm air after it leaves the washer.

Only limited quantities of fruit can be cleaned by hand. The method is to place a single layer only in a ripening tray, the bottom of which has been covered with dampened Turkish towelling. The tray should then be gently shaken back and forth.

Grading the Fruit.

This is not a difficult operation. The fruit passes from the cleaner or washer and dryer to the grading belts, where graders—girls do all this work in America—separate the commercial fruit according to degree of ripeness, and remove all worthless fruit. Segregating the fruit according to the degree of ripeness materially reduces handling and sorting during the maturation process.



Plate 181.

From the fumigator, the dates go into the cleaner and washer, where all dust is removed. They then pass through a drying hood and on to a grading belt, where the fruit is carefully sorted. (Numbers of El Monte high school girls find profitable employment at the new date-packing plant.)

When the fruit is removed from the ripening room it should again be graded, three grades being all that are necessary commercially, namely, first quality, second quality, and fruit suitable for confectionery purposes only. Frequently this grading is done by hand at the packing table as the fruit is being packed.

The recognised American date standards are as follows:—

Fancy Grade.—Only fruits which are of uniformly large size for the variety concerned, free from all insect or fungus injury, conspicuous checks, cracks, or blisters; flesh soft, fibre around the seed cavity tender



Plate 182.

PHOENIX POLISHER AND REGRADER.—Machine used for cleaning and polishing dates of the Deglet Noor and Saidy types—i.e., dry and semi-dry types.

and not all stringy; attractive uniform colour, preferably lighter than natural palm-ripened dates; and with uniform moisture content to ensure satisfactory storage for a reasonable period.

Choice Grade.—The fruits may vary to a limited extent in size and colour; should be free from all insect and fungus injury; skin may show some blistering or checking, but not to such an extent that it materially detracts from the appearance or impairs the eating qualities of the fruit; flesh and fibre well softened; and moisture content reduced to a point whereby the fruit will keep for a considerable period at ordinary room temperatures.

The lowest grade includes all dates, regardless of size or colour, moisture content or condition, provided only that they are a wholesome, palatable product free from insect or fungus injury. This grade requires to be considerably dehydrated so that it will keep for an indefinite period when packed in bulk for culinary purposes.



Plate 183.
Grading Deglet Noor dates.

Artificial Ripening.

The successful handling of this problem is vital to the marketing of dates, and the various methods have been studied for many years by scientists interested in date production. It has now been found that certain varieties do not mature their fruits satisfactorily on the palm. Also, it is recognised that the temperature and relative humidity required not only differ with varieties, but also must be altered according to the degree of ripeness and the moisture content of the fruit being handled. Consequently, certain experimenting would be necessary where seedling dates of unknown origin have to be handled.

It would appear that ripening temperatures range from 95 to 110 deg. Fahr., accompanied by a relative humidity ranging from 60 to 80 per cent. A constant temperature and humidity is maintained by thermostat and humidity controls, similar to those used in the latest banana ripening methods. Electricity is most satisfactory for heating, and to ensure a uniform temperature in all parts of the room the air must be kept constantly in circulation; for this purpose an electric fan

or an air-circulating system involving the use of a rotary or exhaust fan should be provided. Also, a means for expelling the air from the room and replacing it with fresh air is very necessary. This provision may easily be arranged in the air-circulation system or by the use of ventilators. Thermometers placed near the ceiling and floor of the ripening room will give a check on the uniformity of the heat and the efficiency of the fans.

The fruit is held at the ripening heat until the flesh becomes soft and the greater part of the fibre around the seed cavity has broken down into soft date meat. A satisfactory method for testing the maturity of a date is to hold it between the thumb and forefinger and press gently. If the flesh is soft and pliable ripening is complete; if it is hard and unyielding the fruit should remain in the maturation room for a longer period.

The length of time required to ripen dates properly will vary from several hours to three or four days, depending upon the variety and the condition of the fruit at the time it enters the packing house.

Nearly all varieties of soft dates—the Barcaldine dates are all of this type—must be dehydrated to some extent before being placed on the market. Dates which have a moisture content of from 25 to 27 per cent. keep indefinitely at ordinary room temperatures, and can be classed as a non-perishable product. Soft varieties dehydrated to that extent lose their round, attractive appearance, and cannot be sold as fresh fruit on the recognised date markets throughout the world. The term "fresh" when applied to dates means fruit that has been dehydrated only to a degree which makes it semi-perishable or reduces the moisture content to from 30 to 40 per cent. Such fruit must be placed on the market for immediate use or held in cold storage.

Dehydration is accomplished by raising the temperature of the ripening room to from 130 to 140 deg. Fahr., and simultaneously reducing the humidity to 50 per cent. This should be done immediately following the ripening process. It is stated that a temperature of 140 degrees darkens the fruit considerably, and could not be recommended except for those varieties which have a natural dark colour or which carry a very high moisture content. With many varieties dehydration completes the breaking down of the fibre around the seed cavity, and greatly improves the flavour. Men used to this class of work can accurately estimate the moisture content of a date by its appearance and feel, but an inexperienced person can well afford to sacrifice appearance for keeping quality and dehydrate the fruit until it is quite wrinkled.

Packing.

At this stage very little need be said about packing, but it is hoped that in days to come information on this subject will be needed in Queensland.

American growers have reached a high standard in packing dates. Under certain climatic conditions the danger of souring with soft varieties is reduced if some ventilation is provided and consequent loss of moisture permitted. Under similar conditions semi-soft dates and dates used for confectionery purposes require airtight containers to maintain a constant moisture content of the fruit.

From this it will be seen that two distinct types of containers are nearly always required. The Americans pack their "Fancy" and


The graded fruit, on trays, is trucked into the dehydrator, where it is treated until it has the correct moisture content, and sterilized to prevent fermentation after packing.
From the dehydrator, the fruit goes to the packing tables, where girls place it in cartons and jars. These travel over an endless belt under the eyes of an inspector.
The finished product—"California dates."
The jars are capped under vacuum, the natural flavour of the fruit being thereby preserved.
Filled and capped, the jars pass through the sterilizer, a final step insuring keeping qualities.

Plate 184.

"Choice" soft dates in attractive containers having a net weight of from 8 oz. to 5 lb. These containers are of any desired shape, and hold one or more layers of dates. The oblong or square types appear to be the most favoured. Either cardboard or light wooden containers appear to be equally suitable. The inside of the container is preferably treated with a paraffin wax preparation or lined with wax paper, and the individual dates are packed in such a design as to lend attractiveness to the package. It is most advisable to cover these packages with a medium weight cellophane, which not only excludes dust and insects, but also displays the fruit to better advantage. Cellophane also reduces the susceptibility of the dates to damage by surrounding atmospheric conditions.

Fancy and choice semi-soft dates are usually packed similarly to soft varieties in tight moisture-proof containers, which may contain several layers of dates. A transparent window of cellophane serves to display the fruit, and adds attractiveness to each package.



Plate 185.
Date products as they should appear when offered for sale.

The lowest grade of dates is packed in heavy cardboard or wooden boxes holding 20 lb. or more. This grade would enter into direct competition with the imported dates, and therefore care in arranging the fruit would assist in improving its appearance and sale.

Queensland growers should remember that dates are usually consumed without being washed or sterilised by cooking, and should take precautions to place only wholesome, clean produce on the market. It is considered that choice grades of dates could be sold on Australian markets in competition with fancy sweets, but in doing so it would be essential for the container and packing to be as attractive as possible.

Cold Storage.

Cold storage is a necessary operation connected with date production. The present system in California is to prepare the fruit for market and to place it in cold storage at a temperature of 32 deg. Fahr., with a relative humidity of from 65 to 70 per cent. This provides

satisfactory storage for from three to six months, but when stored for longer periods it is advisable to transfer the fruit to a lower temperature, say 18 degrees.

Varieties.

At present Queensland can boast of only a very small area under dates, and these are mostly seedlings possessing no special features whereby they can be listed as being extraordinarily good. Bearing this fact in mind, and knowing that dates will grow satisfactorily in certain districts in Queensland, the following factors should be considered.

In the development of any new horticultural industry the question of varieties best adapted to local conditions and to present and future markets must be given very careful consideration. In the planting of dates even more consideration should be given to varieties than is actually necessary in other orchard plantings, because date palms cannot be grafted or budded. Once a variety is established it cannot be changed except by destroying the planting and replacing it with another having apparently more desirable qualities.

It is estimated that there are 380 commercial varieties of dates growing in the Old World, but importations to other parts of the world have decided those responsible that less than a dozen of these varieties are worth handling when starting out into this particular industry. These varieties can be graded into three distinct types:—The soft dates, the semi-soft dates, and the dry or bread dates.

Soft types, as the name implies, possess a soft, juicy flesh, and ripen in nearly all varieties earlier than the other two types mentioned.

Semi-soft varieties have a high sugar content and a lower moisture content. When cured dates of this class may be stored for months in moisture-proof packages. In California the Deglet Noor and the Zahidi are the two principal varieties of this type grown.

Dry or bread dates have a high sugar content and a very low moisture content, and when cured they become very dry and hard. The Thoory is the outstanding variety of this bread-date class. Palms of this variety are the hardiest grown, and the fruit will keep indefinitely if properly stored.

Before very much can be done in Queensland offshoots will have to be imported from overseas, preferably from Arizona, United States of America, for, although something of value may be achieved by the planting of specially selected seed, the actual risk attached is too great to be undertaken by other than an experimentalist.

The following list records briefly the varieties that are at present growing in Arizona, and that would probably be most suitable for planting in Queensland:—

Deglet Noor.—This variety is considered the finest semi-soft date grown. Due to its high sugar content and low moisture content the fruits keep in cold storage for long periods. Whilst the fruit is ripening it is very susceptible to injury by rain and high atmospheric humidity, and consequently it would not be successfully grown except in a few specially favoured localities. The fruit is large, about 1¾ inches by ¾ inch. The colour changes from light rose to amber when ripe, and to reddish-brown when cured. From 250 to 300 lb. per palm would be very fair cropping.

Halawi.—This is claimed to be the leading variety exported from Southern Iraq to all parts of the world. It is of the soft type and particularly hardy, and could be recommended very strongly. One objection is the somewhat small size of the fruit, but the ease with which it can be artificially ripened compensates for this to a great extent. The fruit is from 1¼ to 1½ inches by ¾ inch. The colour changes from yellow to light amber when ripe, and to golden brown when cured. Production would average from 150 to 200 lb. per palm.

Hayany.—A large, soft type of date, low in sugar content, somewhat difficult to market. It is a heavy cropper, but susceptible to damage from rain or high atmospheric humidity. The fruit is very large, being 2¼ inches by 1½ inches. The colour changes from carmine to purplish black at ripening and curing. Production from 250 to 300 lb. per palm.

Iteema.—A large, soft type date, the fruit of which is very attractive and of excellent quality. The offshoots of this variety are very difficult to propagate, requiring special attention before being removed from the parent plant, and then planting in a nursery for at least two years. The fruit is large, 1¾ inches by 1 inch. The colour changes from yellow to amber at ripening, and to yellowish-brown when cured. Production would average from 200 to 250 lb. per palm.

Khadrawi.—A medium, soft type date, ripening very early, but bearing a somewhat light crop. If planted to itself the distance between the palms of this variety could be reduced from 30 feet to 25 feet. The fruit is of medium size, viz., 1⅜ inches by ⅞ inch. Colour changes from yellow to amber when ripe, and to reddish-brown on curing. Production would average from 125 to 150 lb. per palm.

Khalasa.—A medium, semi-soft type date of fine quality. In California it is reported to be resistant to rain damage. The fruit is of medium size, 1⅜ inches by ⅞ inch, and the colour changes from yellow to amber when ripe, and on curing to a light brown. Production would average from 150 to 175 lb. per palm.

Kustawi.—A hardy, medium, soft type date, the fruit of which is very similar to the Khadrawi. This date is noted for its resistance to injury by heavy rains and high humidity. Usually the heaviness of the crop is such that thinning out to approximately half is necessary, thus materially increasing the size of the fruit. The fruit is of medium size, about 1¼ inches by ⅞ inch, and the colour changes from yellow to amber when ripe, and on curing to reddish brown. Production averages from 150 to 175 lb. per palm.

Maktoom.—A large, soft type date, the fruit of which ripens late in the season and is of excellent quality. This variety should be particularly suitable for Western Queensland conditions. The fruit is large being about 1¾ inches by 1⅛ inches. The colour changes from light yellow to amber when ripe, and to a rich brown on curing. Production would average from 175 to 225 lb. per palm.

Sayer.—A large, soft type date, of hardy habits, which should be suitable for Queensland planting. The fruit is large, about 1¾ inches by ¾ inch, the colour changing from light yellow to deep amber when ripe, and to reddish-brown on curing. The production would average from 175 to 200 lb. per palm.

Sphinx.—An American seedling of outstanding soft type quality. The fruit is large, about 1¾ inches by 1 inch, with the colour changing from carmine to brown-black when ripe and cured. Production ranges from 250 to 300 lb. per palm.

Zahidi.—A small, semi-dry date of fair quality. The fruit is from 1¼ to 1½ inches by 1 inch, with colour changing from yellow to golden brown when ripe and cured. Production is from 225 to 250 lb. per palm.



Plate 186.

This photograph (enlarged) was used as an advertising poster in California under the caption: "Have a date with me!"

Thoory.—This is recognised as the best dry or bread date grown. The fruit is of medium size, with colour changing from yellow to dark brown when ripe and cured. The production is about 200 lb. per palm.

These are the varieties of dates recommended for planting in Queensland. Offshoots should necessarily be free from disease, and will be allowed entry into the State only under supervision of the Department of Agriculture and Stock.

Parlatoria blanchardi, commonly referred to as the Parlatoria Date Scale, is present in Queensland, but fortunately this appears to be the only trouble affecting the palms in this State.

This Department's date experiment block at Barcaldine, which was established in 1935, is a definite move in the right direction. There are 183 young palms growing in this plot, and observations are being recorded from time to time, such observations embracing matters of importance in connection with irrigation, suitability of soil, temperatures, &c. It is hoped that much valuable data will be obtained from these efforts, and that date growing in Queensland on a commercial basis will be an achievement shortly to be realised.

[CONCLUDED.]

FERTILIZERS SOLD IN QUEENSLAND.

A review of the fertilizers registered under the Act for the current year reveals the high standard of materials sold in this State.

The following sets out the kinds of materials sold and the respective percentages of nitrogen (N) phosphoric acid (P_2O_5 and potash (K_2O) present in such materials.

Fertilizer.	Minimum— Nitrogen %	Phosphoric Acid %	Potash %
Nitrate of soda	15.6	—	—
Nitrapo (Potassium nitrate + sodium nitrate)	15	—	15
Sulphate of ammonia	20.6	—	—
Dried blood	11-13	—	—
Superphosphate	—	20.5 (water soluble)	—
Bone dust	3-3.5	22-23.5	—
Meatworks fertilizer	3-6	14-23	—
Basic phosphate	—	17 (cit. sol.)	—
Nauru phosphate	—	37	—
Sulphate of potash	—	—	48
Muriate of potash	—	—	50

A large proportion of the fertilizers distributed in Queensland is sold in the form of mechanical mixtures, i.e., mixtures containing two or more of the above-mentioned ingredients (with the exception of basic phosphate and Nauru phosphate) in varying quantities.

In order that the purchaser may be aware of the composition of the various fertilizers, it is enacted by law that the respective minimum percentages of nitrogen, phosphoric acid, and potash, together with the forms in which they respectively occur, shall be declared on the label attached to each bag. This label should also set out the name of the fertilizer, the net weight, and the name and address of the manufacturer or dealer.

Every sale of fertilizer over the value of 10s. must be accompanied by an invoice setting out the warranty required by the Act.

The labels that must be attached to every bag of fertilizer and the invoice warranty which must accompany the sale are the purchaser's guarantee as to its quality.

It is to the intending buyer's advantage to make himself acquainted thoroughly with the constituents of each fertilizer advertised as useful for his purpose before making a purchase.

The use of the materials tabluated in this note—and mixtures made from them—is sound policy, which can be followed profitably by primary producers concerned.



AUGUST is normally a dry month in Queensland, and this year has proved no exception, as, apart from the scattered rains early in the month, no beneficial falls have been received. The South Coast received only light falls, but the Downs and south-west received from 16 points at Warwick to as high as 1 inch at Talwood. At the time of writing (24th August) pastures are rapidly drying off, and rain is required both to provide feed and to enable the sowing of spring crops.

WHEAT.

The crops are looking promising, but over the greater area now require substantial rain to promote a continuity of growth. Excellent growth was made during July, the wheat stooling out well and being unchecked by the severe frosts which are sometimes experienced. However, the lack of subsoil moisture is now being felt, particularly in the Warwick district, where some crops are reported to be withering. With increasing temperatures, drying westerly winds, and greater transpiration of moisture, it is apparent that rain is now urgently required.

In the Allora and Goombungee districts, where an increased area has been sown, a heavy infestation of wild oats is reported, in many instances to such an extent that it will be necessary to feed off or plough in the infested paddocks. This weed pest is likely to increase unless efficient fallowing and rotation of crops is practised to a greater extent in future years. It is estimated that over 300,000 acres have been sown to wheat during the present season, and owing to the substantial advance in world prices, the return to growers should be greater than that received for many years past. The State Wheat Board has paid 3s. 9d. per bushel for 1935-36 grain to date, and although deliveries were under average only 1 per cent. of the crop was disposed of as feed, no less than 79·5 per cent. of the balance being classified as Q1 standard.

GENERAL.

The harvesting of Atherton Tableland maize has proceeded under good conditions, a record yield of more than 20,000 tons being expected. Sowings of early maturing maize varieties have been made in the southern coastal areas, and are making good progress, although in need of rains at an early date. The spring crop is usually a risky one, but where a failure from grain is indicated such crops can be profitably utilised as fodder or silage.

Local onion growers can anticipate good prices for their crops this year, as, owing to a shortage in the south, values have already exceeded £20 per ton. With October harvesting growers can, therefore, cater not only for local requirements, but also for southern trade, and if due attention is given to packing in new bags and to adequate grading some excellent returns should be realised.



Plate 187.
A Farmer's Home on the Burdekin Delta, North Queensland.

Cotton.

The exceptionally dry weather which has been experienced during August in all the cotton-growing districts has allowed of the harvesting of the cotton crops to be continued under nearly ideal conditions. Although the rate of receivals at the ginneries has naturally slowed down as compared to the previous months, 1,181 bales of lint were ginned during the month—the total number now being 12,881 bales, composed of 9,080 at Glenmore and 3,801 at Whinstanes.

Seed distribution for the coming planting is now well under way—seed sufficient for some 20,000 acres having been distributed to date. It is apparent by the range of applications being received, that a decided increase in interest in cotton-growing is occurring. This augurs well for the desirable expansion of acreage being obtained that is necessary to produce the amount of cotton which will be required by the Australian spinners during the coming season.

Sugar.

Weather conditions during the month have been uniformly dry throughout the sugar areas, with temperatures somewhat lower than normal, and some frosts in the south.

Ratoon crops are making only fair growth. Planting was seriously delayed in northern areas, due to the prolonged wet season, while in the south it is held up pending a suitable fall of rain.

Standover cane is yielding a satisfactory sugar content in the southern districts, but it is considerably below that of last year in northern areas.



SOME TROPICAL FRUITS.

No. 11.—THE SOUR SOP.

S. E. STEPHENS, Northern Instructor in Fruit Culture.

THE Sour Sop is a tree of frequent occurrence in the gardens of North Queensland. The fruit is of a type more suited to garden cultivation than to commercial planting, and its production is therefore more on those lines, hence it is only rarely seen in fruit shops. In the gardens of Cairns and the surrounding district odd trees are commonly met with.

The tree is known botanically as *Anona muricata,* L., and is native of tropical America. It differs from other cultivated Anonas in being practically an evergreen. Only when growing in situations inclined to dry out does it shed its old leaves before the new ones are produced.

The foliage is a dark glossy green, giving the tree an attractive, ornamental appearance. The laurel-like leaves are glabrous, comparatively thick and leathery in texture, up to about 6 inches in length. Flowers are usually produced in profusion, and may arise from any part of the tree, ranging from the trunk and main branches to the previous season's lateral growths. They are large, the three outer petals being up to 1½ inches across. These petals do not overlap one another, but are laid with their margins adjacent, consequently, as they are roughly shield-shaped, the unopened flower has somewhat the form of a three-sided pyramid.

Only a small proportion of the flowers set fruit—in fact, the setting of fruit is characteristically so light that it is regarded as one of the chief drawbacks to commercial cultivation in some countries. Of the limited number of fruit which does set there are nearly always a few that do not develop properly, and produce only malformed specimens. A dozen to twenty good fruits is usually considered an excellent crop for one tree.

The fruit is a large one, frequently up to 10 inches or more in length, quite commonly 8 inches long, and weighing 4 to 7 lb. The outline varies from heart-shaped to almost oblong. The skin is green, thin, and leathery, and its surface is studded with short, green fleshy points or spines arranged in whorled rows extending from the stem end to the apex. The flesh is snow-white and highly aromatic. In texture it is cottony, and to eat it out of hand one is given the impression of chewing a mouthful of cotton wool soaked in juice. The flavour is good, but to enjoy it to the full some preparation is needed. The pulp should be placed in a colander and the juice expressed and drained off into a dish. It may then be made into a fruit jelly with the addition of a little gelatine or it may be eaten as it is after being chilled. Such treatment renders the fruit really delicious. In the Cairns district the season for the fruit is an extended one, commencing about April and lasting over several months.



Plate 188.
Young and half-developed Sour Sop fruit on the lateral branches.

The Sour Sop is more strictly tropical than even the Sugar Apple, and thrives under the moist, humid conditions to be found in the tropical coastal wet belt. On a loose, rich, loamy soil under such conditions of climate the tree grows rapidly. Even on the sandy soil of Cairns trees 15 to 18 feet high and only six to seven years old have been noted. These, however, have been growing at the outflow of a house drain, and were, consequently, abundantly supplied with water at all times of the year.



Plate 189.
The peculiar habit of fruiting on the trunk.

The tree will commence fruiting at three to four years of age, and will continue cropping regularly with practically no attention. W. Popenoe notes, however, that in Cuba liberal dressings of fertilizer have been found beneficial in increasing the amount of fruit produced. The fertilizer used in that country is one containing 3 per cent. nitrogen, 10 per cent. phosphoric acid, and 10 per cent. potash. J. C. Brünnich's

recommendation for anonaceous fruits in Queensland is 1 to 3 lb. of superphosphate, 2 to 6 lb. of meatworks manure with blood, and 1 to 2 lb. of sulphate of potash per tree, according to age, which mixture gives a practically identical formula to that mentioned above.



Plate 190.
Sour Sop tree five years from seed.

Sour Sops are commonly raised from seed, which germinates easily. The seed should be sown in a moist, shaded situation, and may take a month to germinate. Seedlings frequently spring up spontaneously under bearing trees. Vegetative propagation is not practised in this country, but it should be adopted if a particularly desirable tree is ever located. P. J. Webster has found it may be shield-budded successfully.

The chief insect pest attacking the Sour Sop is the Mealy Bug. These insects are frequently found thickly congregated on the fruits. The customary nicotine sulphate and soap spray applied with force is quite satisfactory as a control measure.

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit Packing.

DURING the past month the Royal National Exhibition was held, and many interesting contacts were made. Many were the different viewpoints on marketing met with during meetings with fruit-growers during Exhibition Week. From the aspect of a fruit display the Exhibition was most successful, much excellent fruit being shown. The frequent remarks of the public, "What beautiful fruit; we can't buy fruit like that"—afford material for serious thought. Is it because they will not pay the price? There are plenty of shops which sell good quality fruit.

One of the features of the Department of Agriculture and Stock Court at the Exhibition was a display of tropical fruits, in which an amazing interest was shown by the public. For the period of the Exhibition officers were continuously on duty to give information on the various fruits displayed, and they all remarked upon the interest shown by the public and the numerous requests as to where the fruits could be obtained and how to use them. Most of the fruits came from North Queensland, splendid specimens of granadillas and other tropical fruits being displayed. For the duration of the Exhibition these fruits kept in excellent condition, notwithstanding their previous long journey from Cairns. There is no doubt that North Queensland growers, with everything in their favour so far as the production of these fruits is concerned, are missing a golden opportunity in not making greater efforts to create a tropical fruit trade.

Market quotations have not fluctuated during the month to any great extent, although most fruits showed a tendency to rise in price. Banana prices in Melbourne and Sydney have reached much higher levels than for some time, up to 23s. per case being obtained in Sydney.

Prices on the various markets at the commencement of the last week in August were—

CUSTARD APPLES.

Brisbane prices for good quality fruit ranged from 3s. to 4s. 6d., with some special large sizes to 6s. Sydney prices were from 5s. to 7s. 6d., and Melbourne from 6s. to 8s. Owing to the season drawing to a close, most lines are on the small side.

PAPAWS.

In Brisbane locals brought from 2s. 6d. to 4s. per bushel case, and Gunalda from 3s. 6d. to 5s. 6d., Yarwun from 7s. to 9s. per tropical case. In Melbourne 10s. to 14s. per tropical case was obtained; green lines are unsaleable. Sydney prices were from 8s. to 12s., with special coloured ripe lines to 15s.

AVOCADOS.

Realisations in Brisbane were from 8s. to 10s. per case, and in Melbourne up to 15s. The season for this fruit is now rapidly drawing to a close.

PINEAPPLES.

Brisbane prices for Smooths were from 3s. to 6s. per case, and 2s. to 5s. per dozen; Ripleys brought from 3s. to 5s. per case, and from 1s. to 3s. 6d. per dozen. This market has been rather slow for pineapples during the last few weeks.

Melbourne prices were from 8s. to 9s. per case, with green fruit unsaleable, and not wanted. Prices in Sydney ranged from 8s. to 10s. per case, there being a steady demand for good ripe fruit.

BANANAS.

In Brisbane, Cavendish bananas realised for Sixes 10s. 3d. to 12s. 6d., Sevens 11s. 3d. to 12s. 6d., and Eights 13s. 3d. to 14s. 6d. Immature, thin and ribbed fruit is not popular, yet some growers are showing a tendency to cut their fruit too soon During the cooler weather there is no risk incurred by allowing the fruit to develop a little. Lady Fingers brought from 2½d. to 7d. per dozen for good lines.

Melbourne prices for Cavendish were:—Sixes 14s. to 15s., Sevens 16s. to 17s., Eights and Nines 18s. to 19s. per case, with some special lines at higher prices. In Sydney, Sixes realised from 14s. to 16s. per case, Sevens from 16s. to 18s., and Eights and Nines from 18s. to 21s. per case, with some specials to 23s.

CITRUS FRUITS.

Oranges.—Common oranges on the Brisbane market realised from 6s. to 7s. per case, a few lines from the Gayndah district from 8s. to 10s., and Redland Bay fruit from 7s. to 9s., with some special lines higher. Imported Navels brought from 6s. to 9s.

Mandarins.—Emperors brought from 7s. to 8s., with Gayndah lines to 12s.; Scarlets from 4s. to 9s.; Glens from 8s. to 13s. Many lines of small Scarlets and Glens are hard to clear.

Grapefruit.—Prices ranged from 4s. to 6s. per bushel.

Lemons.—Local lines realised from 4s. 6d. to 6s. per case, and Gayndah fruit from 9s. to 11s. Some lines give the appearance of being uncured, and are consequently hard to sell. Growers should remove lemons from the trees at the beginning of the change from the green colour, and carefully store them in a cool dry place in single layers. The fruit will sweat down and colour excellently, and if the operations have been carefully carried out, will keep for many weeks.

Melbourne citrus prices were:—Lemons, 5s. to 8s.; oranges, common, 5s. to 7s.; grapefruit, 4s. to 9s., skin-marked fruit being hard of sale; mandarins, 5s. to 9s. In Sydney local Navels realised 3s. to 7s., and local Emperors 2s. 6d. to 7s.

PASSION FRUIT.

Attention is drawn to the prices obtained in Melbourne for this fruit, viz., from 14s. to 22s. Sydney prices were from 6s. to 10s. per half-bushel, and Brisbane from 4s. to 11s.

STRAWBERRIES.

Brisbane prices for average quality were from 5s. to 7s. per dozen boxes, with specials from 9s. to 12s. a dozen. In Sydney, trays were from 3s. to 5s., and boxes from 8s. to 14s. a dozen.

TOMATOES.

In Brisbane ripe fruit realised 1s. 6d. to 3s. 6d., green fruit 1s. 6d. to 3s., with coloured lines from 2s. to 5s. In Melbourne, Queensland

re-packed half-bushels brought 6s. to 8s., Adelaide hothouse 10s. to 12s., and West Australian 7s. to 10s. In Sydney from 4s. to 5s. 6d. a half-bushel was obtained.

APPLES.

Growers with apples in cold storage would be well advised to place them on the market in small consignments. All varieties should be removed by mid-September at the latest. The present prices should be quite satisfactory, viz., Granny Smith to 13s., Dunns to 10s., and Delicious to 11s. The Delicious variety is now beginning to open up faultily. Interstate senders to the Brisbane market should take notice that the weather is now warming up, and varieties such as Rome Beauty, Jonathan, and Delicious, under these conditions, do not have a very satisfactory marketing life in Queensland. Large sizes should not be sent under any circumstances.

CUCUMBERS.

Prices in Melbourne for bushel cases were from 15s. to 17s., in Brisbane from 9s. to 11s.

LETTUCE.

Lettuce on the Brisbane market brought from 1s. to 1s. 6d. per dozen. Many growers have adopted the tropical case for packing, a leaflet describing the correct methods to adopt being procurable free upon application to the Under Secretary, Department of Agriculture and Stock, Brisbane, along with other pamphlets mentioned in these notes.

Publications.—A packing chart for lemons is now available, as is also a new publication on apple marketing.

REPLACING MISSING GRAPE VINES.

F. L. JARDINE, Plants Inspector, Stanthorpe.

The propagation of grape vines by layering is an operation usually adopted to fill up the vacant spaces in the vineyard.

After the second year, the replanting of missing vines becomes increasingly difficult and uncertain. Those that do survive are usually dwarfed and unprofitable. It is possible, however, to successfully replace missing vines at any age by layering.

Layering is a simple operation, and may be carried out as follows:—A strong cane of the previous year's growth is selected from a neighbouring vine and, without severing, it is bent down and buried where the plant is to grow, in a trench 8 to 15 inches deep, according to the class of land. The extremity of the vine is allowed to protrude above the surface with a sharp bend, leaving two buds out of the ground. The following summer the portion in the ground makes roots, and also is nourished by the mother vine.

The only care necessary to these layers during the growing season is to remove all growth on the layered cane between the mother plant and where it enters the ground, leaving only that growing from the extremity for the new vine.

After the second season the young vine is severed from the parent, when it may be permitted to carry a reasonable crop.

Growers will be well advised to attend to this matter while the grape vines are dormant. Vacancies in a vineyard, apart from the unsightly appearance, are most unprofitable.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Books of the Australian Illawarra Shorthorn Society and the Jersey Cattle Society, production charts for which were compiled during the month of July, 1936 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS.				
MATURE COW (OVER 5 YEARS), STANDARD 350 LB.				
May 4th of Oakvilla	W. G. Marquardt, Wondai	12,874·2	536·88	Victory of Greyleigh
Champion 9th of Oakvilla (270 days)	W. G. Marquardt, Wondai	11,976·1	498·84	Victory of Greyleigh
Shamrock 6th of Oakvilla (226 days)	W. G. Marquardt, Wondai	10,845·7	416·295	Victorious of Oakvilla
Empress 11th of Sunnyside	Paul Moore, Wooroolin	9,826·75	411·862	Emblem of Sunnyside
Champion 13th of Oakvilla (272 days)	W. G. Marquardt, Wondai	10,310·7	398·699	Gordon of Swanlea
Sunnyside Mabel 10th	Paul Moore, Wooroolin	9,199·5	372·126	Count's Lad of Cosey Camp
Pet 18th of White Park	Bruggemann Bros., Silverleigh	8,757·7	360·635	Violet's Emperor of Hill V ew
JUNIOR, 3 YEARS (UNDER 3½ YEARS), STANDARD 270 LB.				
Navillus Charm	C. O'Sullivan, Greenmount	7,391·75	306·483	Midget's Shiek of Westbrook
SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD 250 LB.				
Redbank Jessie	A. H. E. Black, Kumbia	7,201	268·095	Brundah Warrior
Rosemount Scarlet 8th	A. J. Bryce, Maleny	6,393·8	253·29	Springdale Jupiter
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD 230 LB.				
Boah Peak Melba	Bruggemann Bros., Silverleigh	7,800·85	319·397	Glenroy Royal
College Rascal 3rd	Queensland Agricultural High School and College, Gatton	6,243·06	265·377	Duplex of Greyleigh
Navillus Mavis 3rd	Con. O'Sullivan, Ascot, *via* Greenmount	6,330	262·675	Parkview Mars

JERSEY.

Mature Cow (over 5 Years), Standard 350 lb.

Brooklands Choice Lady (365 days)	W. S. Conochie, Sherwood	12,553·61	758·331	Duster of Brooklands
Liseux Bessie	J. and R. Williams, Crawford	8,226·6	407·23	Zillah's Boy of Liseux

Senior, 4 Years (over 4½ Years), Standard 330 lb.

Gunnawah Opera Queen	F. Maurer, Darra	8,094·95	394·387	Retford Prometheus

Junior, 4 Years (under 4½ Years), Standard 310 lb.

Oxford Ginger Queen	J. E. Smith, Mudgeeraba	5,586·64	344·442	Oxford Robin

Senior, 3 Years (over 3½ Years), Standard 290 lb.

Forward Rosebud	W. S. Conochie, Sherwood	10,643·73	524·345	Forward of Brooklands

Junior, 3 Years (under 3½ Years), Standard 270 lb.

Maiwand Verbena	Queensland Agricultural High School and College, Gatton	5,011·12	324·142	Aveley Rex
Lermont Rosette	J. Schull, Oakey	4,929·8	298·223	Trecarne Fern Lad

Senior, 2 Years (over 2½ Years), Standard 250 lb.

Dawn Jess	A. L. Walker, Dawn	5,806·1	313·452	Retford Glory's Victor

Junior, 2 Years (under 2½ Years), Standard 230 lb.

Brooklands Royal Madge	E. J. and H. G. Johnson, Gleneagle	6,837·88	331·748	Retford Earl Victor
Oxford Kitty	E. Burton and Sons, Wanora	5,121·5	328·997	Overlook Nancy's Remus
Dawn Belle	A. L. Walker, Dawn	4,934·25	304·110	Retford Glory's Victor
Pineview Lucy's Queen	J. Hunter and Sons, Borallon	5,030·98	289·683	Oxford Jeweller
Wyreeme Leonie	J. B. Keys, Wyreene, Gowrie Little Plains	4,250·72	256·80	Goldfinder's Prospector of Mongo
Fauvic Bangle (267 days)	H. Cochrane, Kin Kin	4,479·95	248·677	Condong Double Prometheus
Nimbrae Promise	F. R. Nimmo, Rosewood	4,636	248·212	Oxford Tressidore

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Phalaris—Toowoomba Canary Grass.

A.A.F. (Mondure, via Murgon)—

The grass you sent bore no seed-heads and gave a little difficulty in determining. It is *Phalaris tuberosa*, the Toowoomba Canary Grass, undoubtedly one of the best winter legumes in Australia. On the whole it does better in the cooler climates than the warmer, and we were very interested to learn that it lasted through the summer with you at Mondure. The grass is extremely palatable and on this account we are not surprised that your plants do not get a chance to seed if stock have continual access to them. Seeds should be sown in autumn, but the grass really wants cultivated conditions to do well, and stock should be kept off it for a little time until its roots are established.

Three Weeds.

P.B. (Brooweena, Gayndah Line)—

(*a*) *Raphanus raphanistrum* (charlock). This is one of the weeds known as mustard weed or turnip weed. It is a very common weed of cultivations in Southern Queensland.

(*b*) *Emex australis* (Capé spinach or prickly jack), also known in Queensland as bullhead or cathead burr. This name, however, is applied to a number of burr plants in Queensland. The plant is not known to possess any poisonous properties. It is, however, a very bad weed pest, and should be eradicated when it first appears.

(*c*) *Polygonum convolvulus* (climbing buckwheat). This weed makes its appearance every now and again in cultivation areas in different parts of Queensland. Occasionally it becomes rather a bad pest, but does not seem to spread to the extent of some other weeds.

A Native Bean.

L.H.B. (Chinchilla)—

The specimen represents *Canavolia obtusifolia*, a native bean for which we have not heard the common name. It belongs to the same genus as the sword bean and jack bean—two beans cultivated to a limited extent in Queensland. The latter, which we have grown ourselves, we have found quite an edible bean, both the pods in the young stages and the nearly ripe seeds. The species you send also occurs in the Islands of the Pacific, and we have had always understood it to be dangerous, but a friend who botanised in the New Hebrides for the best part of a year informed us that the beans were a regular source of food to the natives.

Winter Rhodes Grass—"Devil's Fig."

C.S.C. (Mackay)—

1. *Chloris distichophylla* (winter-growing Rhodes grass). This grass seems to be very palatable to stock, but tests made here and in New South Wales show it to possess a prussic acid yielding glucoside in fair quantities. In spite of this, however, like many other prussic acid-yielding plants it seems to be fed on by stock in most cases with impunity. Stock, however, should never be allowed to gorge themselves with it on an empty stomach.

2. *Solonum torvum*, familiarly known in Queensland as Devil's Fig. It is rather a serious pest in some coastal localities.

Mount Larcom Specimens Identified.

W.D. (Bracewell, Mount Larcom, Q.)—

1. *Castanospermum australe* (Moreton Bay chestnut or bean tree). This is a native tree with a durable timber much prized for high-class furniture and panelling. Black bean is the official name adopted for the timber by the Queensland Forest Service. The trees are often faulty and the timber presents some difficulties in seasoning.
2. *Jacaranda acutifolia* (the jacaranda tree), a native of South America.
3. *Schinus molle* (the pepperina tree or pepper tree), a native of South America.
4. *Bauhinia candida* (white bauhinia), a native of Tropical Asia.
5. *Sterculia discolor* (scrub bottle tree).
6. *Ficus Benjamina* (weeping fig), a native of India.
7. *Ficus stephanocarpa* (sand-paper fig), also called purple fig, a native of creek banks in coastal Queensland.
8. *Tamarindus indica.* The tamarin is now widely cultivated in all tropical and sub-tropical countries, and is thought to be a native of Tropical Africa. The name Tamarin is derived from the Arabian Tamare-Hindi, meaning Indian date.

Black Nightshade.

A.G.S. (Bowen)—

Both specimens represent forms of *Solanum nigrum*, the black nightshade, or, as it is more commonly called in Queensland, blackberry. The green leaves and green berries of both plants would be harmful to stock if eaten in any quantity. These species occur in Queensland in a number of forms, and although the ripe berries are eaten freely without any ill effects, the green parts we have always regarded as dangerous, as they contain a poisonous alkaloid, solanin, which tends to disappear from the berries as they ripen. It is just possible that the purple form may contain more of the poisonous principle than the green one, but on this point we are not certain. We would like to see specimens of it later on in berry.

Generally speaking, so far as we have observed, stock seem to avoid these plants when they are growing, although on one or two occasions it has been reported to us that pigs have been poisoned by them, and in the southern States fairly definite reports of sheep having been poisoned by eating the green plants are on record.

Forestry Specimens Identified.

S.D. (Cawarral)—

1. *Eucalyptus tereticornis* (Blue gum). This is a very strong hardwood for general structural purposes. It is said to have high durability in damp situations, and to have excellent resistance to white ant attack.
2. *Euroschinus falcatus, var. angustifolius.* This tree goes under many local names, one of the commonest being maiden's blush. This name, however, we think should be reserved for a different tree with very much broader leaves. The Queensland Forestry Service has adopted the name of blush cugerie for the timber. It is a light soft timber, lacking durability and very susceptible to borer attack.
3. *Cordia dichotoma* (the Sebastian tree). This tree has a wide distribution outside Australia through the Malayan Archipelago to India. In India the wood is considered fairly strong, and is used for boat building and various purposes. So far as we know it is not used here at all. The mucilaginous fruit is used in India as a laxative and to give relief in chest and throat affections.
4. *Melaleuca leucadendron, var. coriacea* (tea tree). The correct spelling of this word is "tea," not "ti" as usually written. The origin of the name is that Dr. Anderson, who was the surgeon and naturalist on Cook's third voyage to Australia, used the leaves of an allied plant as a substitute for ordinary tea, and the drink, if not particularly palatable, was found useful in keeping down scurvy, hence the local name.

There are many varieties of *Melaleuca* in Queensland, and the Queensland Forest Service has adopted the name of Brown Tea Tree for the timber of them. If you have by this time obtained a copy of "The Timbers and Forest Products of Queensland," by E. H. F. Swain, you will find quite a lot said about the timber.

5. *Eucalpytus crebra* (narrow-leaved iron bark), one of the strongest and most durable hardwoods.

Sour or Yellow Grass.

C.F.A.R. (Caloundra)—

The specimen represents *Paspalum congugatum*, generally known in Queensland as Sour Grass or Yellow Grass. This grass is spread very widely over the tropical regions of the world and has been established in North Queensland for a number of years. More recently it has travelled south, and is now found in various localities and in the Northern Rivers of New South Wales, but does not seem to spread to any thing like the extent it does in the North. Farmers in North Queensland are very perturbed about the grass owing to its invading paspalum pastures, very much reducing their value from a dairying standpoint. We have, however, in New Guinea seen mules feed largely on it and work quite well, although, of course, they were supplied with other fodder.

A Common Tropical Legume—A Chickweed.

J.A.P. (Kairi, N.Q.)—

The specimen represents *Alysicarpus vaginalis*, a common tropical legume quite abundant in parts of North Queensland and North Australia. It is palatable to stock, and we should say a valuable addition to the native pasture. We have not heard the local name given to it.

The other specimen represents *Drymaria cordata*, a plant of the Chickweed family. It is spread widely over the Tropics, and is thought to be a native of Central America. It is a very common weed of rice fields in the East, but in Queensland and New Guinea seems to be confined to rather damp situations, as along creek banks, and rather wet scrub edges. It is not known to possess any poisonous or harmful properties, and its allies in cooler parts of the world are quite useful fodder herbs, particularly as green stuff for birds and poultry.

Prickly Poppy.

M.O. (Townson)—

The specimen represents *Argemone Mexicana*—Prickly poppy. This plant possesses poisonous properties, but having a very bitter sap stock generally leave it alone. The only record that has come under our notice of stock having been poisoned by the plant is where the weeds have been cut, allowed to wilt, and the subsequently softened plants eaten by calves.

Elephant Grass.

H.L.E.S. (Harlin, Brisbane Valley)—

The specimen represents elephant grass—*Pennisetum purpureum*. This grass strikes very readily from cuttings which may be put in any time during the spring or summer. In the taller plants the canes become very hard and woody, but if the plant is kept down it makes a bulk of quite good forage for cattle, either for chaffing or feeding off.

A Common Weed in the North.

J.F.O'N. (Richmond, N.Q.)—

The specimen represents *Pterocaulon sphacelatus*, a fairly common weed in North Queensland, but for which we have not heard a distinctive local name. It is sometimes called stink weed, sometimes rag weed. These names, however, are applied to a number of different plants in Queensland. It is not known to possess any poisonous or harmful properties, but seems to be left untouched by stock. It is not new to the North-west, as we have a number of specimens from various localities in Western Queensland, and we have collected it ourselves along Julia Creek.

Burr Medic.

J.R.M. (Goondiwindi)—

The specimen is *Medicago laciniata*, a species of burr medic or burr trefoil, naturalised in Queensland and some of the north-western and western districts of New South Wales. It is nothing like as common as the common burr trefoil (*Medicago denticulata*). It is said to be earlier than the ordinary burr trefoil, and Brakewell, in his "Grasses and Forage Plants of New South Wales," says it is more nutritious, but it does not seem to us to bear the same amount of leafy forage.

General Notes

Staff Changes and Appointments.

The following officers of the Department of Agriculture and Stock have been transferred:—

Messrs. O. L. Hassell, Senior Instructor in Agriculture, from Townsville to Atherton; T. G. Graham, Instructor in Agriculture, from Dimbulah to Townsville; E. W. Baird, Field Assistant, from Townsville to Mareeba; and H. McNee, Cadet, from Mareeba to Dimbulah.

Mr. T. Herbert, Fairymead Sugar Mill, has been appointed an Assistant Cane Tester for the remainder of the season.

Mr. James Purcell, Toowoomba, has been appointed Chairman of the Dairy Products Stabilisation Board until 31st December, 1938.

Mr. A. S. Nicolson, Lindeman Island, has been appointed an Honorary Ranger under the Animals and Birds Acts and the Native Plants Protection Act.

Mr. S. Theodore, care of Tully Sugar Mill, has been appointed Millowners' Representative on the Tully Local Sugar Cane Prices Board, vice Mr. F. N. King, resigned.

The following transfers of Inspectors of Stock, Slaughter-houses, and Dairies have been approved:—Messrs. R. J. O'Sullivan, from Maryvale to Allora; A. R. Betts, from Upper Pilton to West Haldon; S. C. Allan, from Crow's Nest to Grantham; and R. Pusey, from Grantham to Crow's Nest.

Messrs. A. Fordyce (North Side, Mackay) and J. Trevaskis (Farleigh) have been appointed Canegrowers' Representatives on the Farleigh Local Sugar Cane Prices Board.

Mr. Harry Hooper, A.F.I.A., Department of Agriculture and Stock, has been appointed also an Inspector of Accounts under the Pig Industry Act.

Constable J. H. Clay, Dobbyn, has been appointed also an Inspector under the Slaughtering Act.

Mr. A. McDowall, Slaughtering Inspector, has been transferred from Maryborough to Coolangatta.

Constable B. H. Porter, Wandoan, has been appointed also an Inspector under the Brands Acts and the Slaughtering Act.

Mr. W. Peterson, South Bundaberg, has been appointed an Honorary Ranger under the Animals and Birds Acts and the Native Plants Protection Act.

Mr. A. Canty (Red Hill), a qualified candidate, has been appointed an Inspector on probation under the Dairy Produce Acts, the Diseases in Stock Acts, and the Slaughtering Acts, Department of Agriculture and Stock.

The Officer in Charge of Police, Dayboro, has been appointed also an acting inspector of stock.

Messrs. L. J. Pritchard and W. H. Sawford, of the Austinville Banana Settlement, have been appointed honorary rangers under the Animals and Birds Acts and the Native Plants Protection Act.

Mr. W. A. Winchester, of Bundaberg, has tendered his resignation as an honorary ranger under the abovementioned Acts.

The Egg Board.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts, modifying and adding to the Orders in Council constituting the Egg Board, in respect of the acceptance by the Board of the commodity, the payment for eggs, equalisation deductions, the delivery of eggs elsewhere than at Brisbane, the freight on eggs, and the Board's decision regarding the quality of eggs.

The amount of levies heretofore made by the Egg Board may be assigned by way of security to any bank or institution to which the Egg Board may be indebted for financial accommodation for the cost of acquiring land or constructing depots or buildings. The Board may invest the proceeds of any levies or funds of the Board in any approved investment.

Regulations have also been issued under the abovementioned Acts empowering the Board to expend the amount of any levies for the purpose of acquiring land and erecting buildings, or for administrative purposes; and to assign the amount of any levies by way of security to any financial institution to which the Board may be indebted for financial accommodation for the cost of erecting buildings or acquiring land.

Peanut Board.

The election of a growers' representative for District No. 1 (Weinholt and Nanango) of the Peanut Board took place at the Department of Agriculture and Stock, on the 21st August, with the result that the present member, Mr. Young, was returned by a majority of 130 votes.

The voting was—

Leslie V. Young, Wooroolin	253 votes.
Norman J. Christiansen, Wooroolin	123 votes.

Mr. Albert George Whiting, of Atherton, was returned unopposed for the Northern District of the Peanut Board.

Bingera Mill Levy.

Regulations have been issued under the Primary Producers' Organisation and Marketing Acts empowering the Bingera Mill Suppliers' Committee to make a levy of one-farthing per ton on growers whose sugar-cane is loaded at Uping, McIlwraith, Maroondan, and Delan railway sidings, and supplied to the Bingera Mill, such levy to be used for administrative purposes by the Maroondan Branch of the Bingera Mill Suppliers' Committee. Fifty per cent. of the growers concerned may, on or before the 21st September next, lodge a petition for a poll on the question of whether or not the levy should be made.

Banana Levy.

Existing regulations under the Fruit Marketing Organisation Acts covering banana levies have been rescinded, and a new regulation has been issued in lieu thereof, empowering the Committee of Direction of Fruit Marketing to make a levy on all growers of bananas in Queensland for the period from 8th August, 1936, to 31st December, 1939.

The levy shall be at the following rates:—

On all bananas sold or consigned, whether by rail, road, or boat to any agent or company in the Greater Brisbane Area, at the rate of ½d. per case containing 1½ bushels or less; or when marketed in the bunch at the rate of 1d. for every £1 or part thereof of the gross amount realised.

On all bananas consigned by rail, road, or boat, to any agent or company in Queensland to any centre other than the Greater Brisbane Area at the rate of 1s. per ton of cased bananas containing 1½ bushels or less; or when marketed in the bunch at the rate of 10d. per ton, and in either instance a proportionate part of such amount for any fraction of a ton with a minimum of 1d. for any one consignment.

The levy on all bananas railed from any Queensland railway station (except Warwick, Toowoomba, Cairns, Townsville, Mackay, Rockhampton, Central, Roma Street, Brunswick Street, Woolloongabba, and South Brisbane may be collected by the Commissioner of Railways to the extent of 1s. per ton on cased bananas containing 1½ busheds or less, and to the extent of 10d. per ton on bunch bananas.

Slaughtering Licenses.

Regulations Nos. 6 and 7 under the Slaughtering Act have been amended to provide that, in cases where an application for the grant, renewal, or transfer of a license of a slaughter-house is adjourned to enable the applicant to provide suitable premises elsewhere, a provisional license to slaughter stock in his present premises during such time as is reasonably necessary to enable him to obtain such suitable premises elsewhere, may be issued.

Levy for Banana Industry Protection Board.

An Order in Council has been issued under "*The Banana Industry Protection Act of* 1929" providing for a levy on banana growers to be used for the maintenance of the Banana Industry Protection Board. The levy is similar to that of last year, and is at the rate of 1½d. per case containing one and a-half bushels or less, and 2d. in the £1 on the proceeds of sales of bananas marketed in the bunch.

Pineapple Levy.

Executive approval has been given to the extension for a further period of twelve months from the 20th August next of the Pineapple Levy Regulation.

Clifford Park a Sanctuary.

The Clifford Park racecourse and an adjoining property, Westwood, Toowoomba, have been declared a sanctuary under the Animals and Birds Acts.

Snakebite and its Treatment.

The marks of a snakebite were two punctures, sometimes with two or more scratches. In treating a bite on the hand the first thing was to apply a ligature above the elbow without a second's delay. Next, the place should be wiped and the punctures cut through (along and never across the limb) with a piece of broken glass or a sharp blade. Crystals or permanganate of potash should then be rubbed freely into the cut. After an hour the ligature (which should be twisted with a stick very tightly) must be loosened for 30 seconds. This allowed fresh blood to flow, and unless it was done the flesh might mortify. The loosening and retying of the ligature should be repeated every 15 minutes for another hour. When the ligature was put on within half a minute of being bitten recovery was practically assured.—J. R. Kinghorn (Australian Museum) in the "Sydney Morning Herald."

Plywood and Veneer Board.

An Order in Council has been issued under the Primary Producers' Organisation and Marketing Acts, empowering the Plywood and Veneer Board to obtain from manufacturers of plywood and veneer information relating to such commodities, and authorising such Board to appoint persons to inspect the books and accounts of manufacturers or agents.

Plywood and Veneer Board Levies.

Executive approval has been given to the issue of Regulations under the Primary Producers' Organisation and Marketing Acts extending the Plywood and Veneer Board Levy Regulations empowering the Board to make a levy to provide for its administrative expenses; and further empowering the Board to make a levy at the rate of 3d. per 100 ft. face measurement on all pine plywood delivered between the 3rd May, 1936, and the 2nd May, 1939, for subsidising overseas shipments.

Membership of a District Cane Growers' Executive.

The regulation under the Primary Producers' Organisation and Marketing Acts relative to the qualification and disqualification of persons for election as members of a district cane growers' executive has been amended to provide that an officer of a district executive who receives any payment or remuneration at a rate greater than £75 per annum shall be disqualified from being elected to or from continuing to be a member of any executive.

Atherton Maize Board Levy.

Regulations have been issued under the Primary Producers' Organisation and Marketing Acts empowering the Atherton Tableland Maize Board to make a levy on growers of maize at the rate of £1 5s. per ton of maize to provide for the administrative expenses of the Board and for the yearly instalment of interest and redemption due and payable to His Majesty the King.

Members of the Council of Agriculture.

A regulation has been issued under the Primary Producers' Organisation and Marketing Acts prescribing the members of commodity boards who shall be members of the Council of Agriculture. These are:—

Messrs. J. McRobert (Maryborough) and W. J. Sloan (Malanda), the Butter Board; D. G. O'Shea (Southbrook), the Cheese Board; H. R. Brake (Wowan), the Cotton Board; P. G. Martin (Kairi), the Atherton Maize Board; C. Brumm (Woongoolba), the Arrowroot Board; A. G. Whiting (Atherton), the Peanut Board; R. V. Woodrow (Woodford), the Honey Board; H. Kessler (Cambooya), the Barley Board; M. H. Campbell (Albany Creek), the Egg Board; S. Zischke (Hatton Vale), the Broom Millet Board; G. D. O'Neill (Allora), the Canary Seed Board; J. E. Foxwell (Kureen), the Northern Pig Board; K. R. Hack (Nerang), the Committee of Direction of Fruit Marketing; G. Johnson (Mirani, Mackay), the Queensland Cane Growers' Council; W. J. Brimblecombe (Pirrinuan), the Wheat Board; G. A. Duffy (Chairman, Timber Advisory Committee), the Plywood and Veneer Board and the Northern Plywood and Veneer Board.

The following representatives of districts embracing Local Producers' Associations have also been appointed members of the Council of Agriculture:—

Messrs. R. R. Nothling (Hut Creek, via Ambrose), Central Queensland; R. H. Jamieson (Monto), Burnett; W. L. Osborne (Wondai), South Burnett; P. Daley (Maleny), Wide Bay; C. Bateman (Nundah), East Moreton; W. A. Fielding (Laidley), West Moreton; J. Cameron (Millmerran), Darling Downs; W. E. Ashford (Hannaford), Western Downs; J. P. McCarthy (Tolga), Atherton Tableland.

Rural Topics

Premature Calving.

Premature calving is prevalent in many parts of the State, more particularly in the coastal areas, where the rainfall diminishes towards the end of each year, and where there are no introduced grasses.

The trouble is more frequent in dairy herds, which is attributed to restricted pastures and lack of feed containing sufficient nutriment. Other factors predisposing to its incidence are exposure to cold and wet weather.

Premature calving is frequently mistaken for contagious abortion. Many valuable cows and calves—are lost annually through this trouble, principally for the want of knowledge on the part of owners.

As a measure of prevention, stock owners should conserve fodder—lucerne for choice—chaff it up as required, and feed it as soon as the cows commence to lose condition. Even bush hay will do if nothing else is available.

To ensure that each animal gets its share the chaffed feed should be supplied in separate boxes—the stronger beasts cannot then rob the weaker ones. Damp the mixture before feeding, thus preventing the beast from blowing it about when breathing. Hand feed in this way at least every second day.

Pineapple Marketing.

A substantial percentage of cased pines arrive at the market bruised, of which the cause is the use of unsuitable packing material or none at all. It is generally agreed in the markets that good pines packed in woodwool realise at least 6d. per case above the same quality packed in grass or without any packing. Also, a case so packed is more suitable for despatch up country.

Another point is that pines packed in old cases arrive at market at a distinct disadvantage. Buyers definitely prefer new cases. Further—and this, obviously, is very important—old cases cannot be despatched to New South Wales buyers, and so one good market for them is closed.

The old mistake of sending insufficiently coloured pineapples to market is still being made, and good returns are consequently being sacrificed by certain suppliers who would do much better to realise that the market will not pay for what it does not want.

Black Spot of Plums.

In the Stanthorpe district, a number of varieties of Japanese plum have, for the past few seasons, been affected with black spot. This is a bacterial disease which disfigures the fruit and causes a shot-hole effect on the leaves and cankers on the stems. Large limbs or even whole trees may be lost from the canker stage, and the fruit spot often renders a considerable portion of the crop unsaleable. The disease is worse in low lying and poorly-drained situations, but is by no means confined to such places.

Spraying experiments have been conducted for several years in an attempt to check the trouble. At first, summer cover sprays with zinc lime were tried, as successful results had been reported from America with this spray used against a similar disease. The only result of these experiments was to prove conclusively that zinc lime was without effect on the disease.

Last season, a number of other sprays were tried. The results indicated that copper sprays, such as Bordeaux mixture, will control the disease. Sulphur sprays, such as lime sulphur and colloidal sulphur, have no effect. Unfortunately, Bordeaux mixture cannot be used on plum trees after blossoming. Dormant spraying alone does not give full protection, and it is not yet certain that the disease can be adequately controlled by sprays prior to blossoming. Experiments to determine the best schedule of sprays are now under way. In the meantime, growers are advised to spray susceptible varieties of plum, such as October Purple, Doris, Shiro, and Santa Rosa, with Bordeaux mixture at bud burst and again between bud burst and the opening of the blossoms. The first application can be made at full strength, namely 6:4:40, but for the second, it may be advisable to reduce the strength to 3:2:40.

Picking Bags and their Pitfalls.

How often do fruit growers, when harvesting fruit, think of the amount of damage caused by the use of picking bags? Observation has shown that the amount of stalk injury to fruit when handled is much greater when picking bags are used.

As it takes twelve months to produce a crop of fruit, surely the exercising of caution by using picking tins and handling each individual fruit should more than repay the little extra time involved.

With citrus, the grower protects the stalk end from fractures by clipping all fruit, and then rolls the fruit through the picking bag, allowing the buttons to damage the cheeks of the fruit.

Observations in the apple packing sheds disclosed that stalk damage for which the packing was often blamed took place before the fruit reached the sizing machines.

These observations give rise to the thought, "Are picking bags worth while?"

Mammitis Milk.

There is undoubtedly need for a fuller appreciation of the losses that may accrue from mammitis milk.

Many dairy farmers are well aware of the seriousness of such infected cows, but perhaps do not realise the full significance from an economic standpoint.

Such udder infections must be regarded as of outstanding importance, which result in great annual financial losses.

The loss of cows, loss of supply, decrease in quality of milk and cream, and diminution in nutritive value illustrate briefly the consequences involved. Acute mammitis has been known to cause the death of dairy cows. However, of equal importance is the lower milk yield which inevitably follows the loss of the milking function in a quarter.

Compared with normal milk, mammitis milk contains less casein, fat, and sugar, with increased alkalinity and salt, and also possesses a disagreeable flavour. Such properties make mammitis milk entirely unsuitable for butter and cheese manufacture.

Unknowingly, the farmer loses many pounds per annum from defective milk and cream being graded down.

This illustrates the need for early action, and the following advice will prove helpful to the farmer in detection and control of this defect:—

1. Look out for lowered milk yield, and especially loss of the milking function in a quarter of the udder. At the same time examine the foremilk for clots or flakes.

2. The curd remaining after straining each cow's milk through fine black silk will also give a rough indication of infected cows.

In considering control methods, it must be borne in mind that such an udder infection is contagious, so that by far the most important consideration consists of:—

1. Segregation of infected cows and increased hygiene.
   (*a*) If cows are being machine milked, it is advisable to hand milk for a period in order to pick out the infected cows and then isolate these.
   (*b*) The use of weak Condy's or potassium permanganate as a disinfectant and strict cleanliness will prevent the spread to other cows.
   (*c*) Before milking, wash hands in weak Condy's and repeat with each cow.
2. Cows that show abnormal milk or any signs of udder infection should be milked last.
3. Cloths used in wiping their udders should not be used on normal cows.
4. The foremilk should not be milked on to the floor.
5. Use milking machines only on healthy cows.
6. Older cows are more commonly infected.

With these few considerations, we see the need for early detection of such a disease in your herd, and also the immediate application of control measures.

Such a matter urgently requires attention in order that losses may be reduced to a minimum.

Green Cestrum—A Dangerous Weed.

Several cases of a poisoning of cows and poultry by the green cestrum have been brought under the notice of the Department within recent months. Horses seem rarely to touch the plant, but cows will eat it if fresh feed is scarce, even if, as in the case of many town cows, they are fed on chaff and are in first-class condition. They seem to have a particular liking for the plant at this time of the year.

The poisoning by the plant is rapid, the symptoms at first being constipation with blood-stained fæces. This is rapidly followed by a general paralysis, and death in great pain. As the plant is very much on the increase, and suckers very badly, it should be eradicated immediately on introduction into a locality.

For the purposes of identification, it may be said that the plant is a shrub 4 to 5 feet high, with dull-green leaves, and yellowish-green or brownish-green flowers in bunches at the ends of the branches. The plant rather prefers shady situations, though it is by no means confined to them. Cases of poisoning of poultry have occurred where the plant has been growing against netting fences, and fowls have picked at the green leaves.

The plant is a native of Chili and the Argentine, South America, and the poisonous principle is due to an alkaloid, and is not destroyed by drying.

Farmers suspecting they have the plant in their districts are advised to send specimens to the Department for correct identification.

The Feeding and Management of Poultry Breeding Stock.

The development of the embryo chicken during the process of incubation depends to some extent on the nutrients in the egg, and, of course, it is readily understood that the quality of the contents of an egg is in accordance with the food consumed by the fowl. For the embryo to develop into a strong vigorous chicken, the egg should be rich in vitamin A; therefore it is necessary to supply to the breeding stock foodstuffs containing this vitamin. Without it the growth of the young will stop and death will eventuate.

Foods that are rich in vitamin A are green food, yellow maize, milk, and cod liver oil, whilst meat or protein meals, wheat, bran, and pollard are deficient.

Having a knowledge that this vitamin is so essential to the life of the embryo, and knowing the foods that contain it, consideration must now be given to the most economical method to adopt in supplying it. Without doubt the best and cheapest method of supplying vitamin A is by feeding ample freshly cut green feed. In addition, greenstuff is rich in vitamins C, E, and G, and also contains minerals. It might be pointed out that vitamin E aids fertility, whilst G is another valuable aid to the growth and development of the embryo and young. In the feeding of greenstuff supply the birds with as much as they will consume. If wet mash is fed, greenstuff could comprise to upwards of one-third by measure of the bulk of the mash; when the system of feeding is dry mash, moisten the greens, if not moist, and add a few handfuls of mash to the greens, mixing thoroughly, and give as a mid-day meal; the addition of the mash will increase the palatability of the greens. Green lucerne chaff could be soaked in cold water overnight, if fresh green feed is not available.

Maize is an excellent food, and it would be an advantage to feed this grain to breeding birds even though it is more costly at present than wheat. Milk, unless available on the farm, would probably be too costly, whilst the cost of cod liver oil is prohibitive compared with greenstuff.

In feeding breeding birds it is an advantage for them to consume more grain than mash, as the grain will have the effect of reducing any tendency to the stimulation of egg production; therefore always feed as much grain as the birds will eat.

In the management of breeding birds do not tolerate broody hens on the nests. Get them away, otherwise germination may take place and the eggs will be spoilt for incubation purposes. The eggs should be gathered frequently, at least twice daily. The eggs should be cleaned by scraping if soiled and stored in a cool place, but not in draughts. Draughts cause a rapid evaporation of the contents which is detrimental to the hatching quality of eggs.

Make regular inspections of the perches for mites, as these parasites are sucking blood from the birds, weakening their vitality, with the natural sequence of poor hatches and weak chickens. Occasionally examine male birds for body lice, and if necessary give them a dusting with some insecticide so as to relieve them of these pests.

The Mons Marie Banana.

Many inquiries are being received from various centres throughout the banana-growing areas in Queensland as to the possibility of planting the Mons Marie variety of bananas during the coming planting season. Such inquiries embody a request for information as to where clean plants are available and the price that would be asked for same per hundred.

For the benefit of those growers who have not produced this variety of fruit previously, it is advised that certain conditions must be strictly observed if satisfactory returns are to be obtained from the planting of the Mons Marie.

Firstly, there are two distinct types listed under the heading of Mons Marie. The first is a tall-growing variety possessing very many characteristics that definitely ally it with the variety Gros Michel. This particular type has a definite characteristic inasmuch as the lower portion of the bunch stem discards every trace of the small immature fingers so typical of the Cavendish variety, and from the actual flower up to the last hand of mature fruit there remains an absolutely bare stem.

The second type is more dwarfed, being taller than the Cavendish but possessing many characteristics which definitely ally it with this variety. The bunches are of Cavendish type, but whereas in the first type mentioned the bared stem is so noticeable, in the second type this stem carries the small immature fingers as does the Cavendish.

Both types produce fruit that is absolutely similar in appearance and quality, but favour is given the more squat growth owing to the greater amount of wind resistance that this particular type possesses.

Another feature to be considered is that this variety generally is not as hardy in its growing habits as is the Cavendish, and therefore requires to be grown on rich land in a sheltered position, the shelter being essential because of the somewhat weak character that this variety possesses; that is, the breaking-off of the bunches when possibly three parts matured, the actual break always occurring just inside the pseudo-stem. Propping under such conditions is a difficult task owing to the section that appears so weak in this plant and also on account of the height that the plants attain. Observations indicate that land that will produce Cavendish fruit of fair quality would in many instances be incapable of producing fair quality Mons Marie. As mentioned before, rich land, a good rainfall, and abundance of shelter are positive essentials for the production of the latter variety. Attempts made to produce Mons Marie on land other than that mentioned above have resulted in failure, the bunches being very small, the plants of a wind-stricken and stunted nature, and an excessive leaf fall always being noticeable.

Growers would be well advised to seek the advice of the Department prior to planting this variety not only for guidance in respect to the locality in which it is desired to plant, but also to definitely ascertain a reliable source from which plants of this variety may be obtained.

Sweet Potatoes as a Pig Feed.

Sweet potatoes have a high value as pig feed; both the roots and vines are very palatable to pigs, and it is not necessary to boil the roots before feeding; in fact, the most economical way to feed this crop is by allowing pigs to do the harvesting.

Where the paddock system of pig raising is adopted, a pig paddock may be planted in sweet potatoes, then by erecting a temporary fence across the paddock, the pigs may be turned on to the crop when it is ready to harvest, the temporary fence being moved along as each section of the crop is cleaned up by the pigs.

Sweet potatoes may satisfactorily replace a large part of the grain in a pig's diet, provided sufficient separated milk or meat meal is fed in conjunction.

Approximately 3½ lb. of sweet pototoes are equal in feeding value to 1 lb. of maize, and when the vines are fed also, it may be estimated that about 3 lb. of sweet potatoes and their vines are equal to 1 lb. of maize, which means that a 3 tons-per-acre crop is required to give the same pig food as a 40-bushel crop of maize. Under conditions which would produce a 40-bushel crop of maize in the Queensland coastal districts, at least a 6-ton crop of sweet potatoes may be expected, which means that sweet potatoes may be expected to give twice as much pig feed per acre as maize grain.

Although it is claimed that sweet potato vines are good cattle food, caution is necessary as cases of supposed stock poisoning as a result of eating the vines have been reported from time to time.

Poultry—How to Cull.

Very definite characters are associated with high egg production, and the breeder who is to make a success of poultry raising must acquaint himself with these characters, discarding from his flock all birds which do not possess them. There are birds, however, which are exceptionally good layers that do not look the part. They are the exception to the rule, and it is better to lose a few good birds in the process of culling than to retain a lot of indifferent ones by not making an effort to get rid of the undesirable.

The good producer in the first place will be active, alert, and strong in appearance. Cull the sluggish and the weak. The sluggish will invariably be overfat, indicating for what purpose she has been using her food; and the weak thin, suggestive of her inability for sustained production.

The body of a good layer should have length, depth, and width proportionate to the breed. Females are usually deeper at the rear than in front, but the bird lacking in front is to be avoided. Look for the female with a back wide throughout its entire length, avoiding birds which have not well sprung ribs and narrow to the base of the tail. Judge the width of back by running the hand down the entire length, thumb one side and fingers the other. Width can also be judged by the distance the legs are apart.

Many of these features can be judged while the bird is at liberty in the pen, and those appearing undesirables caught with a catching hook for further examination. As the catching of birds frequently disturbs the whole flock, with a consequent fall in production, it is suggested that a lot of the examination of poultry can be done at night when the bird is on the perch. It is possible to ascertain the exceptionally fat and those not in good enough condition. Such birds can definitely be marketed with advantage. It is possible also to ascertain at night if a bird is laying or not by the condition of the pelvic bones and the distance between the pelvic bones and the keel.

With a bird in lay, it should be possible to place two fingers between the pelvic bones and three or more between the pelvic bones and the keel. The good layer should have a soft, pliable abdomen, full, but not hard. If she is a good producer, she should have a full crop, indicating her appetite. As all good fowls of suitable age should now be in a production stage, those not showing these qualities could be removed from the pen for market purposes or at least for further examination. As the measurement of pelvic bones and distance between pelvic and keel are variable in nature, it cannot be used as an accurate method of culling, except during the period when all birds should be in a production stage.

The head of the bird is one of the best means of culling, provided it is associated with a bird carrying the body characters referred to.

The comb and wattles should be of medium size, fine and waxy in texture. High producers generally have a head of good width, flat on top and width carried well back. The eye bright, round, and prominent, and placed high in the head. The bird with the sunken eye, and one lacking expression or brightness, is to be avoided. The face should be bright, skin of fine texture, and as free from feathers as possible. Beak strong and slightly curved.

In all directions look for quality, but avoid building up an over-refined class, as strength is essential to production.

Kookaburras and Snakes.

Thus, Alec Chisholm, in "The Australasian":—

In reply to J.M.T., of Bendigo (V.), I suggest that kookaburras rarely attack large snakes since their poor equipment would not allow them to do so with safety. A Victorian bushman some years ago told a good story on the subject:—A kookaburra had grabbed a snake about 3 feet long, and his mate rallied to his assistance.

One bird had the snake gripped behind the head and the other near the tail. The bird holding it near the head was silent, and trying every now and then to knock the snake's head against the ground, the hen bird at the tail end making all the flapping and noise. When the observer tried to get closer the birds carried off the snake for about 200 yards, the male bird getting on to a limb, but the other one could not get her end up, and she and the snake were dangling beneath the limb.

Finally they dropped it, and running up lest the snake should get away, the man found that the snake's head had been almost bitten off. He left it to the birds to finish the job.

Orchard Notes

OCTOBER.

THE COASTAL DISTRICTS.

OCTOBER is frequently a dry month over the greater part of Queensland, consequently the advice that has been given in the notes for August and September regarding the necessity of thorough cultivation to retain moisture is again emphasised. Thorough cultivation of all orchards, vineyards, and plantations is therefore imperative if the weather is dry, as the soil must be kept in a state of perfect tilth, and no weeds of any kind must be allowed to grow, as they only act as pumps to draw out the moisture from the soil that is required by the trees or fruit-yielding plants.

All newly planted trees should be carefully attended to, and if they show the slightest sign of scale insects or other pests they should receive attention at once.

Bananas.

In the warmer districts banana planting may be continued. All winter trash should be removed and the stools cleaned up. If not already done, before the winter, young plantations planted the previous season should be desuckered without delay. Those desuckered last autumn should be gone over again, and also old plantations should be attended to. Grow to each stool the number of stems which experience proves to be permissible, but only allow each stem to grow a single follower. Borers will soon be active again, and trapping should be intensified towards the end of the month and supplies of Paris green and flour (one part to six by weight) made up in readiness. Caterpillar and grasshopper plagues often occur from the end of the month onwards, and it is wise to lay in a stock of a few lb. of arsenate of lead for use in the preparation of bran baits. Watch the plantation carefully for bunchy top, and kerosene and destroy any affected plants without delay. The season of vigorous growth is now commencing, and it will pay well in more and better fruit and in stronger suckers for the next crop to apply a dressing of a complete fertilizer to each stool. Cultivate well to retain moisture, aerate the soil, and kill weeds before they seed. This will also prepare the soil for the planting next month of a green cover crop such as *Crotalaria goreensis*, thus shading the soil, preventing erosion on slopes, and enriching the soil with nitrogen and humus.

Clean out all banana refuse from the packing shed, and resolve not to allow it to accumulate in future. This will reduce the risk of the development of many fungous rots in the packed fruit.

Pineapples.

From now onwards pineapples may be planted in most districts. Plough thoroughly, remembering always that in the life of a plantation will be several years during which it will not be possible nor desirable to do more than disturb the surface layer. Obtain advice from the Department of Agriculture and Stock as to whether the soil is sufficiently acid, and, if not, how much sulphur to apply. Care must be taken in the layout of the rows to save time and labour in cultivation and harvesting, and minimise erosion. Select planting material with discrimination from healthy and vigorous plants of a good bearing type. Beware of planting "collars of slips." Always strip off the base leaves and dry in the sun for a few days, and plant shallow. As soon as the roots form, apply 3 cwt. of 10-6-10 fertilizer to the acre. All established plantations are due for their spring fertilizer at not less than 5 cwt. per acre. Keep down weeds with the Dutch hoe; but do not disturb the soil deeply, always remembering that the pineapple is shallow-rooted and receives a sharp setback if the roots are interfered with by the use of horse-drawn implements. Clean out all pineapple refuse from the packing shed and surroundings, and thus eliminate much fungous trouble in the summer pack.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

MUCH of the matter contained under the heading of "The Coastal Districts" applies equally to these parts of the State; for on the spring treatment that the orchard and vineyard receives the succeeding crop of fruit is very largely dependent. All orchards and vineyards must be kept in a state of perfect tilth, and no weed growth of any kind should be allowed. In the western districts, irrigation should be given whenever necessary, but growers should not depend on irrigation alone, but should combine it with the thorough cultivation of the land so as to form and keep a fine soil mulch that will prevent surface evaporation.

All newly planted trees should be carefully looked after, and only permitted to grow the branches required to form the future tree. All others should be removed as soon as they make their appearance. If there is any sign of woolly aphis, peach aphis, or scale insects, or of any fungus disease on the young trees, these diseases should be dealt with at once by the use of such remedies as black leaf forty, Bordeaux mixture, or a weak oil emulsion. In older trees, similar pests should be systematically fought, as if kept in check at the beginning of the season the crop of fruit will not suffer to any appreciable extent. Where brown rot has been present in previous years, the trees should be sprayed with Bordeaux mixture and lime sulphur according to the schedule recommended by this Department. All pear, apple, and quince trees should be sprayed with arsenate of lead—first when the blossom is falling, and at intervals of about three weeks. Spraying for codlin moth is compulsory in the fruit district of Stanthorpe, and wherever pomaceous fruit is grown it must be attended to if this insect is to be kept in check.

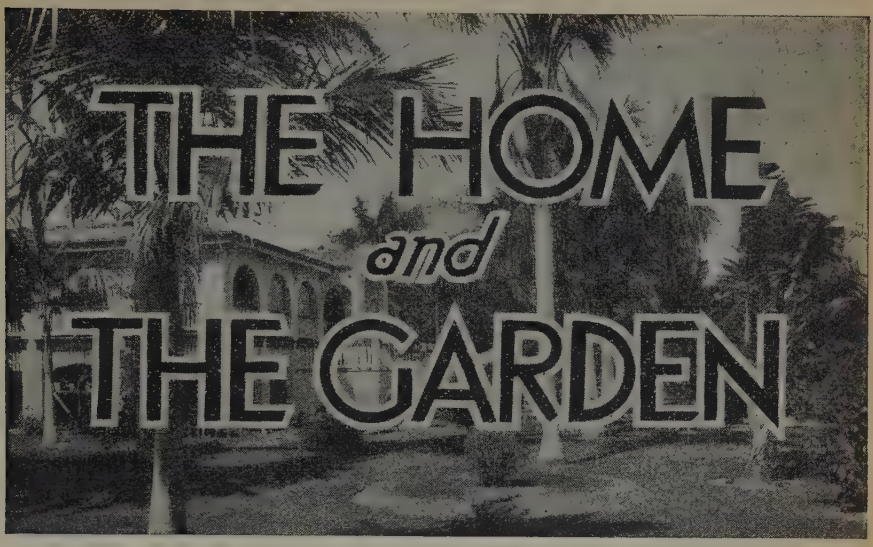
In the warmer parts a careful check should be kept for any appearance of the fruit fly, and, should it be found, every effort should be made to trap the mature insect and to gather and destroy any affected fruit. If this is done, there is a good chance of saving the earlier ripening summer fruit, if not the bulk of the crop. Tomato and potato crops will require spraying with Bordeaux mixture, as also will grape vines. Keep a very strict watch on all grape vines, and, if they have not already been treated, don't delay a day in spraying if any sign of an oil spot, the first indication of downy mildew, appears on the top surface of the leaf. Spraying with Bordeaux mixture at once, and following the first spraying up with subsequent sprayings, if necessary, will save the crop, but if this is not done and the season is favourable for the development of the particular fungus causing this disease, growers can rest assured that their grape crop won't take long to harvest.

Where new vineyards have been planted, spraying is also very necessary, as if this is not done the young leaves and growth are apt to be so badly affected that the plant dies.

Farm Notes

OCTOBER.

FIELD.—With the advent of warmer weather and the consequent increase in the soil temperature, weeds will make great headway if not checked; therefore, our advice for last month holds good with even greater force for the coming month. Earth up any crops which may require it, and keep the soil loose among them. Sow maize, cowpeas, sorghums, millet, panicums, pumpkins, melons, cucumbers, marrows. Plant sweet potatoes, yams, peanuts, arrowroot, turmeric, chicory, and ginger. Coffee plants may be planted out. There are voluminous articles in previous journals giving full instructions how to manage coffee plants from preparing the ground to harvesting the crop, to which our readers are referred.



OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

MOTHERCRAFT.

THE term "mothercraft" implies the simple science of the art of good mothering—the essentials in regard to feeding and environment for the child—the hygiene of body and mind. We still shy at the word "science," but science really means simplification—it is just crystallised common sense.

One would urge every mother to prepare herself beforehand, not only for the birth of the baby, but in the matter of mothercraft generally. Knowledge applied in time would prevent the great majority of early weanings and many tragedies. A great French doctor has pointed out that premature separation of mother and child by early weaning or by premature birth is the greatest cause of infant death. But the ideal scheme of mothercraft commences even earlier than this "with the girls in their teens, the potential mothers of the next generation—thus providing education and supervision over the whole cycle from the expectant mother to the infant and pre-school child, and thus to the schoolgirl, and so to the mother again.

"Mothercraft" is a word to conjure with. If it is not allowed to become vague and shadowy, it serves a very useful purpose in reminding us that mothering must be learnt like any other craft. What an extraordinary thing it is that girls are trained for almost every profession and occupation under the sun except the most important of all! No profession, public or private, can match it. Motherhood may not

bring women before the public gaze as other outlets for their energies may do, but the mother should be competent to rear and nurture her children, and every mother who fulfils these duties well has played her part in the public health service of the country.

The human infant remains helpless for a longer period than any other living creature. How stupid and how cruel it is that we should allow the helpless baby to be the subject of experiment—make it the material on which the mother learns the job she should have learnt before, with the risk of "spoiling" it, or worse, in the process!

The time will surely come when we shall look back with amazement on the school curriculum for girls, so crowded that no time could be spared for the teaching of the rudiments of child-care.

The Mothercraft Home.

We hope to have a Mothercraft Home in Brisbane, where the mother whose milk supply has failed or is failing may come in for treatment, which in the great majority of cases results in the complete or partial restoration of the supply in a short time. In many cases natural feeding can be re-established after days or even weeks of complete weaning.

Mothers and babies can also be admitted for twenty-four hours' observation and test-weighing in order to ascertain just how much milk the baby is getting from the breast, with a view to accurate adjustment and correct advice. The nurses in charge of the mothercraft homes will have had wide experience in the management of difficulties in connection with natural feeding. It will be their aim to make the mother feel "at home"—that she and her baby will be considered as individuals with individual problems for solution, not "cases" in for treatment.

The second fortnight or so of baby's life is apt to be a little critical, especially in the case of a first baby. The mother, perhaps young and inexperienced, is apt to find herself unexpectedly weak, nervous, and easily upset when she returns from the nursing home or when she is left by her nurse. Unskilled in the management of the baby, possibly harassed by conflicting advice from her well-meaning friends and relations, and worried by her baby crying, the mother may lose her milk or overfeed her baby under the impression that the baby is hungry. In a very short time this sort of thing can cause the young mother to become anxious, nervy, and exhausted, and transform the beautiful, healthy, breast-fed baby into an ailing bottle-fed one. This, no doubt, is citing an extreme case, but in some form or degree the story is all too common and all too true. The mistakes are not due to carelessness, but to lack of knowledge. Only knowledge, properly applied, can correct the results and prevent recurrences.

Premature Babies.

The care of premature babies is another important part of the mothercraft homes. These tiny mites can be admitted to the home within a few hours or days of birth, if necessary. In most cases the mother will be admitted with her baby as soon as she is fit to come in.

IN THE FARM KITCHEN.

BEEF RECIPES.

[*Continued from p.* 303, *August*, 1936.]

Broiled Steak.

The best cuts for broiling are from the loin—porterhouse, short cut or club, and sirloin. Choose a tender steak at least 1 inch thick. Wipe meat with a clean, damp cloth and place on a broiler which has been oiled by rubbing with a piece of fat. If a small amount of water is put in broiling pan there is less odour and spattering of fat. The broiler should be placed 2 to 3 inches below flame. If a gas oven is used, do not close the door.

Sear meat on one side, using a high temperature (500 deg. F.), then turn and sear other side. Reduce heat and continue cooking until steak is puffy, brown, and sufficiently cooked. After steak is seared do not turn until done on one side. Avoid puncturing steak with a fork while cooking, as it permits juices to escape. Allow thirty to forty minutes for a 2-inch steak according to whether it is to be rare or well done. Remove to a hot serving dish, spread with butter, and season with salt and pepper.

Pan-Broiled Steak.

Prepare as for broiled steak. Rub a bit of fat over bottom of a smoking-hot frying pan. (An iron pan is desirable, as it retains heat well.) Place steak in pan and sear first one side, then the other. Reduce heat and cook to desired degree, turning as needed. Pour off fat as it accumulates in pan. Serve as for broiled steak.

Oven Roast of Beef.

For an oven roast a tender cut, as prime ribs or loin of beef, is best. Chuck, rump, or round may also be used. Wipe, trim into a neat shape, tying or skewering if needed. Place on a rack in a roasting pan and cook at a constant temperature in slow oven. Allow fifteen minutes per pound for rare, eighteen minutes for medium, twenty to twenty-five minutes for well-done beef. With these cuts no water or fat need be added, as meat will cook in its own juices and fat. If roast is seared either at the beginning or the end of the cooking process flavour, aroma, and colour are more pleasing, but there are greater losses. Sear in a hot oven for ten to twenty minutes, and then reduce heat to a slow oven and complete cooking.

Pot Roast of Beef.

Good cuts for pot roast are round, rump, cross-arm, or chuck. Wipe, trim, tie, or skewer into a compact shape. Dredge with salt, pepper, and flour, rubbing mixture well into cut surfaces. Brown in some of meat fat in a hot frying pan or kettle in which meat is to be cooked. Place in a kettle, if not already there; add hot water to one-fourth depth of meat; cover tightly; simmer slowly until tender. The time cannot be stated definitely. It will probably require at least three hours for a 4-lb. roast. Turn several times during cooking. Remove meat, thicken liquid with gravy, allowing two tablespoons flour for each cup broth.

Sliced carrots, onions, celery, or other desired vegetables may be added during the last hour of cooking. This allows time for blending of flavour. Potatoes are added later, as they need only to be cooked until tender.

Spanish Steak.

Select a thick steak and pound into it with a hammer all of the flour possible. Melt one-fourth cup of bacon fat in a pan, and when hot add the steak. Brown well on both sides, then pour over it one cup of water and one-half can of tomatoes, a couple of medium onions chopped fine with a minced green pepper and seasoning. Turn the flame low and simmer gently until tender, or bake in a moderate oven. A fireless cooker is excellent for preparing this dish.

Short Ribs of Beef en Casserole.

Take 3 lb. short ribs, 6 small onions, 1 carrot, 4 tablespoons fat, ¼ teaspoon pepper, 1½ teaspoons salt, 1 teaspoon sugar, 2 cups canned tomatoes, ½ cup rice, uncooked.

Melt fat in a frying pan, add onions and beef, and brown well. Put into a casserole. Mix tomatoes, rice, sliced carrots, and sugar, and pour over the beef. Add enough hot water to cover all ingredients, cover and cook in a slow oven for three hours.

Braised Beef.

Take ¼ cup each of diced carrots, turnips, and celery, ¼ cup chopped onion, salt and pepper to taste, flour, 3 lb. meat (chuck, brisket, or lower round), 2 small, thin slices fat salt pork (drippings may be used), 3 cups boiling water.

Try out pork, strain if desired. Wipe meat, rub with salt and pepper, dredge with flour, brown in hot fat. Place in a casserole, cover with the vegetables, add water, cover, and bake slowly until tender—about four hours. Eight servings.

Flank Steak en Casserole.

Take 1 flank steak, well scored, bread stuffing, salt, pepper.

Wipe steak, season with salt and pepper, spread with stuffing. Roll steak with grain of meat and skewer or tie. Brown in a little hot fat. Place in a casserole, add water or stock to half its depth in pan. Cover, bake slowly about two hours or until tender. Remove to serving dish, thicken stock, and pour over meat. If desired, the meat may be cooked on a bed of diced carrots, turnips, and celery, and tomatoes may be added for part of the liquid.

Broiled Hamburg Steak on Onion Rings.

Take 2 cups ground lean raw beef, ¼ cup ground suet, 1 cup soft fine breadcrumbs, 7 strips bacon, 7 slices Spanish onion ½ inch thick, 1 tablespoon chopped parsley, 3 tablespoons butter, 2 teaspoons onion juice, ½ teaspoon salt, ⅛ teaspoon pepper, 1 tablespoon water.

Lay the slices of onion in a buttered shallow baking dish. Pour over them two tablespoons of melted butter, sprinkle with salt and pepper, add the water, cover closely, and bake in a moderate oven for thirty minutes, or until tender. In the meantime cook the chopped parsley in one tablespoon of butter, and combine with the beef, suet, crumbs, and seasoning. Knead until thoroughly mixed. Mould into seven flat cakes and wrap each with a slice of bacon. Place each cake on an onion slice in the baking dish, and broil under direct heat for five minutes on each side. Baste occasionally with the drippings. Serve at once from the baking dish. If it is not convenient to broil the meat cakes by direct heat pan-broil them in a hot skillet and serve on the onion slices.

Chuck Stew.

Take 4 lb. chuck, cut up, 2 tablespoons bacon fat, 1 Spanish onion, minced, 2 green peppers, cut fine, 2 cups stewed tomatoes, 1 cup carrots, chopped 1 cup celery, chopped, 2 teaspoons salt, 2 cups water.

Have the beef cut up as for stew; dredge with flour and brown well in the bacon drippings. Place in a kettle with the other ingredients, cover closely and cook slowly on top of stove for about three hours. Thicken the gravy with flour rubbed smooth in a little cold water.

Braised Round Steak.

Take round of beef, 4 tablespoons fat, 1 onion, minced, 1½ green peppers, sliced, 3 tops of celery stalks, 3 sprigs parsley, minced, 2 carrots, sliced, 6 medium-sized potatoes, 2 cups milk, 1 teaspoon salt, ⅛ teaspoon pepper, 1 cup flour.

Season flour with salt and pepper and rub thoroughly into the steak. Melt fat in a frying pan and brown steak over a slow fire. Pour milk over steak and arrange vegetables around it. Cover and cook in a slow oven until the milk is practically absorbed.

Liver Loaf.

Take 1½ lb. liver, 1½ cups stale breadcrumbs soaked in 1 cup milk, 2 eggs, beaten, ½ cup stock, 2 tablespoons fat, 1½ teaspoons salt, ⅛ teaspoon pepper, 1 tablespoon parsley, 1 tablespoon onion, 1 tablespoon celery, ½ green pepper, if desired.

Run liver and vegetables through chopper. Combine with other ingredients and mix well. Pour into an oiled baking dish, set in pan of hot water, bake one and one-half hours in a slow oven (300 deg. to 350 deg. F.). If a soft crust is desired, cover until last fifteen minutes of baking.

Brain Oysters.

Take 1 brain, 2 eggs, 1 tablespoon milk, salt, breadcrumbs, parsley.

After the brain has been parboiled, separate into pieces about the size of large oysters. Dip into slightly beaten egg to which one tablespoonful of milk has been added, roll in seasoned crumbs, then dip into egg and roll again in the crumbs. Fry in deep fat until a golden brown. Serve hot, garnished with slices of hard-boiled egg and parsley.

Sweetbreads may be prepared in the same manner.

Beef Kidney, Creole Style.

Take 1 beef kidney, 1 thick slice bacon, 2 tablespoons chopped suet, 4 tablespoons flour, 1 sweet pepper, 1 pint canned tomatoes, 1 teaspoon salt, ⅛ teaspoon cayenne pepper, ½ teaspoon curry powder, 4 onions.

Trim the fat from a fresh kidney and cut in ¾-inch slices. Dredge with flour. Fry the chopped bacon and suet in a deep saucepan, add the kidney, chopped onions, and pepper, and turn until the meat is thoroughly seared and coated with a rich brown gravy. Add the tomatoes and seasoning cover closely and simmer three-quarters of an hour. Serve very hot on narrow strips of buttered toast.

Canning of Beef.

Meat is regarded as one of the more difficult foods to can since the botulinus organism may develop in it. The pressure cooker is ideal for use in canning all meat since it insures better sterilisation of the product.

Choose any cut of fresh, clean beef which has been cooled at least twenty-four hours after killing, wipe with a clean cloth, bone if desired, and then cut into neat pieces of a suitable size to fit the jar or for serving.

Method I. (Cooked Meat).—The meat is partially cooked before packing it into jars in order to shrink it and insuring thorough processing. Cut the meat into pieces one-fourth to one-third larger than that desired for packing, as this allows for shrinkage. Then roast, broil, or cook in a small amount of fat until about half done. Season, then pack into jars, filling to within ¾ inch of the top. Add pan liquor in the quantity desired, adjust the cover, and partially seal. Process about fifty minutes for pints and sixty minutes for quarts at 15 lb. of pressure, or allow ninety minutes at 10 lb. pressure. Remove jars from the canner and seal immediately.

Method II. (Raw Meat).—This method gives a product with a less desirable colour and flavour than that cooked before canning, so is seldom recommended. It is also more difficult to process, and shrinkage is greater.

Pack raw meat into jars rather tightly, as meat will shrink in processing, but allow for the circulation of heat and liquid. Use one teaspoon of salt for each quart. Adjust the cover, partially seal. It is best not to add water, as the meat will make its own liquor. Process one and three-fourths hours at 10 lb. pressure. Remove jars and seal.

Processing Beef for Home Use.

Curing beef at home is not extensively practised by those who butcher. One hundred and thirty reporters say no curing is done, while eighty parties process some meat for home consumption. Efforts seem to be rather largely centered on canning. Cold packing is general in these homes, and the pressure cooker is also utilised.

Where nearby cold-storage facilities are available many carcasses are kept under refrigeration for future use. When so handled it is customary to cut beef into pieces which can be cooked and used within a short time after taking them from the cooler. Charges made for storing meat in this way are nominal, and a minimum amount of preparation is involved—the carcass is quartered or further subdivided, the pieces wrapped in muslin, and then taken to the storage plant.

Comments on home practices follow:—

Dickinson County.—Pieces of hindquarters weighing 8 to 15 lb. are salted, packed in salt in large jars, and allowed to remain five to six weeks. Chunks are then ready to smoke.

Gove County.—Large-sized chunks are cured in brine five weeks. Brine composed of 3 gallons water, 6 lb. salt, 2 lb. brown sugar, ½ oz. saltpeter is boiled, then cooled and poured over meat. After five weeks hang up to dry. Smoke lightly and hang in dry place to keep for summer use.

Harvey County.—Can, cold-pack method. Place in cold glass jars, seal and boil three hours, then tighten, seal and put away.

Utilising Scraps.

In reply to the question of how scrap pieces of a beef carcass are handled to prevent waste, the following suggestions are made:—

1. Make hamburger or else can poorer cuts and trimmings.

2. Flanks are seasoned with hickory smoked salt and pepper, then rolled, tied and cooked until done, used as cold sliced beef.

3. Suet is used for puddings or for soap.

4. Bones are used in making stock soup which may be canned for subsequent use.

5. Scraps are ground, seasoned, cold-packed, and canned for use in croquettes and sandwiches.

6. Tongue boiled and pickled.

7. Scraps and wastage used in lieu of tankage.

Bologna Style Sausage.

Ingredients: Take 60 lb. cured beef, 40 lb. pork, 20 lb. water, 1½ to 2 lb. salt, 2 oz. mace, 1 oz. corriander, 4 oz. black pepper.

The beef should be ground, seasoning added, and the bulk stored away for thirty-six to forty-eight hours before using it for sausage. Fresh meat stuffed into casings and smoked invariably spoils. After this preliminary step the beef should again be put through the grinder, using the fine plate. Put the pork through the grinder only once, using the medium plate. Then put the beef and pork together in a container and add the spices and water. Mix thoroughly until it takes on a dull colour and becomes sticky. Stuff in weasands, large beef casings, or in beef rounds. Allow it to hang about twenty minutes in a cool place. This sausage can also be stuffed into muslin bags and paraffined. It will keep perfectly prepared in this way. Smoke for about two hours, or until a good colour is obtained, at a temperature not to exceed 140 deg. F. (After the bologna is smoked it should be boiled, the weasands and rounds about thirty minutes and the larger bolognas about one and one-half hours, at a temperature of 160 deg. F. To tell when bologna is cooked enough, squeeze it in the hand, and if done it will squeak when the pressure is released. Place in cold water for about thirty minutes, and then hang it up in a cool place to keep.

Frankfort or Vienna Style Sausage.

Ingredients: Take 70 lb. beef, 30 lb pork (not too lean), 20 lb. water, 1½ to 2 lb. salt, 2 oz. nutmeg, ¼ oz. black pepper, 1 to 2 oz. red pepper.

Cut the beef into small pieces and salt and allow it to cure for forty-eight hours in a cool place. Cut the pork into small pieces and put the beef and pork through the grinder together. Put into a container and add the water and spices. After it is all mixed, put it through the grinder again, using the fine plate. Stuff into sheep casings. After the sausage is stuffed into the casings by means of the thumb and forefinger, press the casing together about 4 inches apart. Twist the link two or three times. The next link should be twisted in the opposite direction to keep the casing from untwisting. After it is twisted into links hang it in the smokehouse for about two hours at a temperature not to exceed 125 deg. F. After it is smoked, boil it for five or ten minutes and then plunge it into cold water and hang it in a cool place.

The following directions for corning and drying are taken from Farmers' Bulletin 183, U.S.D.A.:—

Corned Beef.

The pieces commonly used for corning are the plate, rump, cross ribs, and brisket, or, in other words, the cheaper cuts of meat. The loin, ribs, and other fancy cuts are more often used fresh. The pieces for corning should be cut into convenient size joints, say, 5 or 6 inches square. It should be the aim to cut them all about the same thickness so that they will make an even layer in the barrel.

Meat from fat animals makes choicer corned beef than that from poor animals. When the meat is thoroughly cooled it should be corned as soon as possible, as any decay in the meat is likely to spoil the brine during the corning process. Under no circumstances should meat be brined while it is frozen. Weigh

out the meat and allow 8 lb. of salt to each 100 lb.; sprinkle a layer of salt ¼ inch in bottom of barrel, pack in as closely as possible the cuts of meat, making a layer 5 or 6 inches thick; then put on a layer of salt and follow with a layer of meat; repeat until the meat and salt have all been packed in the barrel, care being used to reserve salt enough for a good layer on top. After the package has stood overnight add for every 100 lb. of meat 4 lb. of sugar, 2 oz. of baking soda, and 4 oz. of saltpeter dissolved in a gallon of tepid water. Three gallons more of water should be sufficient to cover this quantity. In case more or less than 100 lb. of meat is to be cured, make the brine in proportion. A loose board cover weighted down with a heavy stone should be put on the meat to keep all of it under brine. In case any should project rust would start and the brine be spoiled.

It is not necessary to boil the brine except during warm weather. If the meat has been corned during the winter and must be kept into the summer season, the brine should be watched as spring approaches, as it is more likely to spoil at this time. If the brine appears to be ropy or does not drip freely from the finger it should be turned off and new brine added after carefully washing the meat. Meat should be kept in the brine from twenty-eight to forty days to secure a good corning.

Dried Beef.

The round is commonly used for dried beef, the inside of the thigh being considered the choicest piece, as it is slightly more tender than the outside. The round should be cut lengthwise of the grain of the meat in preparing for dried beef, so that the muscle fibres may be cut crosswise when sliced for the table. A tight jar or cask is necessary for curing. The process is as follows:—To each 100 lb. of meat weigh out 5 lb. of salt, 3 lb. of granulated sugar and 2 oz. of saltpeter; mix thoroughly together. Rub the meat on all surfaces with a third of the mixture and pack it in the jar as tightly as possible. Allow it to remain three days, when it should be removed and rubbed again with another third of the mixture. In repacking put at the bottom the pieces that were on top the first time. Let stand for three days, when the pieces should be removed and rubbed with the remaining third of the mixture and allowed to stand for three days more. The meat is then ready to be removed from the pickle. The liquid forming in the jar should not be removed, but the meat repacked in the liquid each time. After being removed from the pickle the meat should be smoked and hung in a dry attic or near the kitchen fire, where the water will evaporate from it. It may be used any time after smoking, although the longer it hangs in the dry atmosphere the drier it will get.

IN THE FARM GARDEN.

THE GARDEN COMPOST HEAP.

THE garden compost heap is a cheap means of converting garden and household vegetable refuse into valuable fertilizing material. Materials such as lawn clippings, spent crops free of disease, vegetable tops, &c., should all be used in this manner, but the coarse, woody stalks of strong-growing plants should not be used.

The production of artificial manure from garden waste, straw, &c., consists in the decomposition, by fungi and bacteria, of much of the plant material. The nitrogen in the process is converted from an inorganic to an organic form, and is present in increased amount in the material finally produced. The rapidity with which the process goes on is influenced by the type of material, its degree of maturity and chemical composition, and by the presence of nutrients such as lime, phosphate, nitrogen, and potash, for the organisms carrying on the decomposition are much akin to plants in their requirements.

Actual damage can be done to crops, other than some legumes, by the addition of uncomposted, poor-quality material to the soil. This damage is due largely to a lack of available nitrogen in the soil. Such poor-quality materials as bush scrapings, dry mature grass or straw, offer a good source of energy for the soil bacteria and fungi, which rapidly increase in numbers, and in so doing consume all the available nitrogen. This competition for soil nitrates results in the nitrogen starvation of crop plants.

The usual process of allowing plant refuse to decay without any chemical treatment results in a very acid product, providing no immediately available nitrogen. With nitrogen-poor plant residues it becomes necessary to add available nitrogen to the heap, as well as lime, which prevents the development of acidity, and phosphate, which is required in the nutrition of the organisms. With nitrogen and mineral-rich materials such as legumes (peas, beans, &c.), green vegetable tops, and other green succulent material, the use of lime alone should be sufficient to enable rapid decomposition.

With general refuse or poor-quality material, a heap can be made on a square base, and of such size that the final height is about 3 feet. Spread the chopped-up material in layers several inches deep, treating each layer in the following manner:—

Snow over with ground limestone (5 lb. per 100 lb. material), fork in loosely, give a sprinkling of superphosphate, and then add sulphate of ammonia at the rate of 1½ lb. per 100 lb. material. The material should be moistened before building up the layers, if not already moist. Ammonia may be given off slowly, so that it is necessary to keep building up and treating the successive layers quickly, so that it will not be lost. The final layer is not treated, and may be given a covering of an inch of soil. When next the heap is added to, the untreated layer can be moistened and treated.

When the heap is at the full height, after subsidence due to compaction and loss of material by bacterial action, the heap can ferment under the untreated capping, which can be used as a base for the next heap. The heap should be kept damp, but water should not be added in quantity sufficient to cause drainage from the heap.

In summer the material should be ready for use after two months, but in cold weather the process is much slower.

Artificial manure properly prepared is very similar in chemical composition to composted horse manure, and gives equally good results in promoting plant growth.

FERTILITY OF THE HOME GARDEN.

Intensive gardening demands a higher degree of soil fertility than does ordinary field crop culture. An efficient system of soil management should not only make allowance for the present crop, but should aim at an ever-increasing reserve of fertility. It should determine the necessity and value for the particular soil of organic matter, how most economically to apply this material, then attempt to supplement this where necessary, by liming and the addition of artificial fertilizers.

Organic matter has an important function in the growth of plants as a source of carbon dioxide, in improving the physical condition of the soil, in increasing the water-holding capacity, allowing root penetration, and modifying extremes of soil temperature. In addition to providing some of the mineral constituents required in greatest amount, organic matter provides certain rare, and little understood elements, usually not considered in the preparation of artificial fertilizers. Heavy soils in which the fine particles accumulate in large masses, and crack badly on drying, can only be improved in texture by liming when acid, and the addition of organic matter to prevent the clods from cementing.

In general, the richer the food of animals in fertilizing substances the richer their excreta, particularly the liquid portion. This contains most of the potash and a great deal of the nitrogen, but only a small amount of the phosphate which passes through their bodies; further, it contains these substances in a form ready for the immediate use of the plant. It is therefore important to realise that unless precautions have been taken to include it with the solid excreta, most of the valuable fertilizing constituents have been lost.

The kind of animal affects the fertilizing value of manure. Horse manure is richer and more readily decomposed than cow manure, since the mineral requirements of the milking cow are much greater than those of the horse. Poultry manure, when fresh, is a rich fertilizer compared with horse or cow manure; it contains more than twice as much nitrogen and phosphate, but has only about the same amount of potash. The bulk of its nitrogen is present in an easily available form, hence it is a quick-acting or forcing nitrogenous manure.

Animal manure as commonly procurable has not been carefully conserved against the loss of fertilizing constituents, and unless the liquid portion has been included, a considerable portion of the nitrogen present is not of use to plants. It must be regarded as an unbalanced fertilizer, and the fertilizer balance can be greatly improved by the separate use of superphosphate, and sulphate or chloride of potash.

Where the organic matter of the soil is maintained by using manure, a degree of fertility will be maintained, but an annual application of 100 to 150 lb. per 100 square feet will be necessary.

LIME FOR THE GARDEN.

Lime fulfils many functions which are essential to soil fertility. Its most useful action is in neutralising the acidity of strongly acid soils, for with the removal of acidity the other valuable effects of liming follow. Lime improves the physical condition of heavy acid soils, ensuring better drainage and aeration, and making cultivation easier, and is an essential plant nutrient, and when present in sufficient amount promotes many phases of bacterial activity, especially those ultimately bringing the reserves of nitrogenous material in the soil into the soluble forms of nitrogen which plants utilise.

There is no foundation for the common statement that exposure of acid soil to sun and air "sweetens" or reduces its acidity. Acidity is developed through an insufficiency of lime in the original soil-forming material, or by the loss of lime, through leaching, and absorption by plants. Acidity thus developed can only be counteracted in field or garden practice by the use of some form of lime. The forms of lime used for counteracting soil acidity are hydrated or slaked lime, and ground limestone or carbonate of lime.

Slaked lime is formed by the action of water on burnt or stone lime, and forms a very fine powder which can be efficiently spread. Ground limestone is a cheaper and more pleasant material to handle than slaked lime, and can nearly always be relied on to give as quick and good results as slaked lime, provided the material is sufficiently fine and well distributed, and that equivalent dressings are applied. In the last respect, 4 lb. of carbonate of lime are required to supply as much "effective" lime as 3 lb. of slaked lime contains.

The soil to be limed should be dug over and reduced to good tilth, the lime uniformly spread, and then lightly worked into the top several inches of soil. The amount of lime to be used depends on the degree of acidity of the soil, its texture, organic matter content, and the type of plant to be grown. Unless all these features can be determined, suggestions on the amount of lime that it is necessary to add to a soil can only be approximate.

On loams and heavier soils, dressings may range from 1 lb. of slaked lime, or 1½ lb. ground limestone, per square yard on loams, to double these quantities on clay loams and clays. Sandy loams or still more sandy soils can receive lighter dressings of approximately half the amount for loams. Lime is lost most rapidly from sandy soils, which are usually more acid than heavier soils under the same conditions. Under garden conditions, with frequent waterings, lime is continually being lost, especially from the sandier types of soil. After the initial liming, which may need to be heavy to counteract strong acidity, it is preferable to add light dressings each season, rather than occasional heavy dressings.

It is not always necessary to add sufficient lime to completely neutralise soil acidity, as most garden plants grow well on slightly acid soils. This slightly acid condition will only result in the majority of garden soils after liming. Only for those plants listed below as very sensitive to acidity is it advisable to completely neutralise acidity. Whilst many plants grow best on neutral soils or on slightly alkaline (opposite of acid) soils, a considerable number of plants will tolerate fairly acid soils. The latter are not adversely affected by being grown in limed soils, though many plants which require a good lime supply may fail on acid soils.

By careful planning of the garden cropping scheme, portion of the area may be set apart and only lightly limed, if at all, for certain plants (as indicated below), and the remainder limed for those crops with a higher lime requirement. Potatoes, which will grow on acid soils, do best on slightly acid soils, and in gardens where dry conditions are not experienced the danger from scab diseases in slightly acid soils is small.

The following statement shows the relative sensitiveness of a number of garden and crop plants to acid soil conditions:—

Very Tolerant.—Parsley, potato, radish, strawberry, sweet potato, tomato, cowpea, maize, millet, oats, rye.

Tolerant.—Bean, Brussels sprouts, carrot, choko, cucumber, endive, kohl rabi, pea, pumpkin, rhubarb, squash, turnip, watermelon, crimson clover, vetch.

Sensitive.—Broccoli, cabbage, cauliflower, eggplant, sweet corn, barley, rape, red clover, sweet clover, wheat, white clover.

Very Sensitive.—Asparagus, beet, celery, lettuce, onion, parsnip, spinach, lucerne.

Evidence is available to show that excess of lime under certain conditions may depress plant growth. Overliming may result when the calculated amount of lime is applied to the surface zones of soil, and not worked to the proper depth. Overliming injury is produced only on heavily-limed acid soils, and not on non-acid soils, or soils which have previously been limed. This injury is not permanent and is usually overcome by the time the first crop is removed. Lettuce and lucerne are crops which may suffer from bad lime distribution.

Large additions of organic matter such as compost, manure, &c., are very effective in reducing overliming injury, and this fact is of importance in indicating that a liberal addition of green or stable manure should be applied to the soil if immediate liming and seeding are necessary. Where very heavy dressings of lime are necessary, it may be advisable to apply lime in two successive seasonal applications. After the preliminary liming, the lime added in a well-made compost will go far to counteract natural losses of lime from the soil.

FEED REQUIREMENTS OF DAIRY COWS.

Owing to the dry season experienced in some of the dairying districts an extreme shortage of both pasture and cultivated fodder crops has occurred, and this shortage should emphasise the great value of conserving fodder in the form of hay or ensilage.

A certain quantity of food is required to maintain the animal in a healthy, normal condition, and for milk production feed over and above the quantity used for maintenance is required.

The indigestibility of the nutrients in the different foodstuffs varies very considerably, and all young plant life contains a higher quantity of protein than does matured growth, and also all nutrient matter is in a much more digestible condition in the younger stages of plant growth.

The daily maintenance feed for a 1,000-lb. cow should contain 0.7 lb. of digestible crude protein and about 8 lb. of total digestible nutrients, and then for every gallon of milk with 3.5 per cent. fat produced the cow will require more feed containing about ½ lb. of digestible crude protein, with from 2¾ lb. to 3 lb. total digestible nutrients. The nutrients required in the daily feed for maintenance of production of 1 gallon of milk will be practically 1¼ lb. digestible crude protein with a total nutrient content of 10¾ lb. Briefly stated, feedstuffs may be said to be composed of water, organic dry matter, and mineral matter. That cows can only consume a certain amount of dry matter must be recognised, and a general rule is that dry matter up to 3 per cent. of the body weight of the animal may be eaten daily—thus 30 lb. dry matter may be eaten by a 1,000-lb. cow. If mineral deficiency exists in the animal's feed such can be remedied by suitable stock licks.

Too great dependence for feeding is placed upon the natural grasses, for when dry times occur (unless some form of hay or silage has been conserved) the stock are frequently unable to obtain sufficient food, even for maintenance, from the old matured grass roughage of grazing paddocks.

In illustration—a sample of grass roughage upon which cows were feeding was examined, and it was found that to obtain even the amount of digestible crude protein required for maintenance 2½ times the dry matter possible of being consumed would be required. In this case 25 lb. of the grass roughage with 3¼ lb. lucerne chaff, or with 1 lb. lucerne chaff and 1 lb. cottonseed meal would be sufficient to maintain the animals, but insufficient for both maintenance and milk production.

Regarding paspalum, if not in the mature stage of growth 47 lb. would provide sufficient protein but not quite sufficient total nutrients for maintenance; the nutrients could be supplemented by maize meal. For maintenance and production of 1 gallon of milk (this low production has been quoted purposely) 84 lb. green paspalum would be sufficient.

Detailed information concerning feeds and rations for dairy cows are published in "Stock Foods" and "Rations for Dairy Cows," which pamphlets are obtained free upon application to the Department of Agriculture and Stock, Brisbane.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF JULY IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	July.	No. of Years' Records.	July, 1936.	July, 1935.		July.	No. of Years' Records.	July, 1936.	July, 1935.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In
Atherton	1·00	35	2·07	0·34	Clermont	1·05	65	0·73	3·70
Cairns	1·53	54	1·74	0·41	Gindie	1·14	37	..	3·49
Cardwell	1·36	64	1·28	0·50	Springsure	1·22	67	1·80	4·51
Cooktown	0·95	60	1·45	0·60					
Herberton	0·85	50	1·16	0·07					
Ingham	1·62	44	1·19	3·94					
Innisfail	4·59	55	7·18	3·31					
Mossman Mill	1·25	23	1·20	1·32	*Darling Downs.*				
Townsville	0·62	65	0·27	0·59					
					Dalby	1·73	66	2·00	1·52
Central Coast.					Emu Vale	1·59	40	2·59	1·66
					Hermitage	1·76	30	..	1·44
Ayr	0·69	49	..	0·78	Jimbour	1·53	48	2·05	1·04
Bowen	0·94	65	..	0·34	Miles	1·65	51	2·50	1·86
Charters Towers	0·65	54	0·30	1·75	Stanthorpe	2·04	63	2·87	2·14
Mackay	1·70	65	0·55	1·46	Toowoomba	2·10	64	2·40	2·01
Proserpine	1·56	33	1·36	0·52	Warwick	1·84	71	2·50	1·60
St. Lawrence	1·41	65	0·23	3·13					
South Coast.									
					Maranoa.				
Biggenden	1·41	37	0·34	2·85					
Bundaberg	1·86	53	0·75	5·37	Roma	1·48	62	1·69	1·92
Brisbane	2·23	85	1·31	2·06					
Caboolture	2·20	49	1·28	2·59					
Childers	1·72	41	0·54	3·99					
Crohamhurst	3·01	43	1·80	5·11					
Esk	1·98	49	1·56	2·44					
Gayndah	1·47	65	0·46	2·21					
Gympie	2·12	66	1·17	2·82	*State Farms, &c.*				
Kilkivan	1·62	57	0·45	1·54					
Maryborough	1·92	65	1·48	3·86	Bungeworgoral	1·43	22	1·20	..
Nambour	2·72	40	1·12	4·30	Gatton College	1·42	37	1·47	1·93
Nanango	1·67	54	1·24	1·49	Kairi	1·11	22	..	..
Rockhampton	1·79	65	0·40	4·28	Mackay Sugar Experiment Station	1·53	39	0·45	1·53
Woodford	2·39	49	1·57	2·95					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—JULY, 1936.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Means Atmospheric Pressure, at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·98	79	69	82	4, 25, 27, 29, 31	60	1	145	8
Herberton	..	70	54	80	27, 28	40	1	116	14
Rockhampton	30·16	73	55	82	26	43	1	40	8
Brisbane	30·21	69	51	75	30	40	1	131	8
Darling Downs.									
Dalby	30·21	66	43	73	15	29	19	200	7
Stanthorpe	..	58	36	67	2	23	19, 20	287	14
Toowoomba	..	61	43	67	4	29	19	240	10
Mid-Interior.									
Georgetown	30·02	82	59	91	29	43	1	91	2
Longreach	30·13	73	47	81	11, 23	35	7, 8	126	3
Mitchell	30·20	67	40	76	24	26	19	157	5
Western									
Burketown	30·01	82	58	90	27, 28	49	1, 8	Nil	..
Boulia	30·10	74	50	87	25	40	7	24	2
Thargomindah	30·16	66	44	78	24	33	6	28	2

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	September, 1936.		October 1936.		Sept. 1936.	Oct., 1936.
	Rises.	Sets.	Rises.	Sets.	MOONRISE. Rises.	MOONRISE. Rises.
					p.m.	p.m.
1	6·7	5·37	5·33	5·51	5·23	6·21
2	6·6	5·37	5·31	5·51	6·28	7·31
3	6·5	5·38	5·30	5·52	7·34	8·41
4	6·3	5·38	5·29	5·53	8·42	9·48
5	6·2	5·39	5·28	5·53	9·49	10·51
6	6·1	5·39	5·27	5·54	10·56	11·49
7	5·59	5·40	5·26	5·54	..	..
					a.m.	a.m.
8	5·58	5·40	5·25	5·55	12·1	12·41
9	5·57	5·41	5·24	5·55	1·1	1,23
10	5·56	5·41	5·23	5·56	1·56	2·3
11	5·55	5·42	5·22	5·56	2·43	2·35
12	5·53	5·42	5·21	5·57	3·24	3·10
13	5·52	5·43	5·20	5·57	3·53	3·40
14	5·51	5·43	5·19	5·58	4·34	4·11
15	5·50	5·44	5·18	5·58	5·7	4·41
16	5·49	5·44	5·17	5·59	5·38	5·17
17	5·48	5·45	5·16	5·59	6·8	5·51
18	5·47	5·45	5·15	6·0	6·39	6·30
19	5·45	5·45	5·14	6·1	7·14	7·13
20	5·44	5·46	5·12	6·1	7·52	8·0
21	5·43	5·46	5·11	6·2	8·30	8·52
22	5·42	5·47	5·10	6·3	9·15	9·46
23	5·41	5·47	5·9	6·3	10·4	10·44
24	5·40	5·47	5·8	6·4	10·38	11·43
25	5·39	5·48	5·8	6·5	11·55	12·42
					p.m.	
26	5·38	5·48	5·7	6·5	12.55	1.45
27	5·37	5·49	5·6	6·6	1·59	2·49
28	5·36	5·49	5·6	6·7	3·2	3·54
29	5·35	5·50	5·5	6·7	4·7	5·4
30	5·34	5·50	5·4	6·8	5·13	6·13
31			5·3	6·9		7·25

Phases of the Moon, Occultations, &c.

1 Sept.	○	Full Moon	10 37 p.m.
8 „	☽	Last Quarter	1 13 p.m.
16 „	●	New Moon	3 41 a.m.
24 „	☾	First Quarter	8 12 a.m.

Perigee, 3rd September, at 8.48 p.m.
Apogee, 19th September, at 10.42 a.m.

The swift planet Mercury, which since the beginning of the year has travelled through fully eight constellations (at intervals with apparently retrograde motion) from Sagittarius to Virgo, will become stationary on 18th September, after which it will seem to move westward for nearly a month, but still remain in Virgo.

On the 19th Neptune will be in conjunction with the Sun and therefore invisible for some weeks.

On the 23rd Jupiter and the Moon will be separated by only one degree, but again the phenomenon will occur far below the horizon.

At 3 p.m. on the 23rd the Sun will cross the celestial equator from North to South and it will be the Australian Vernal Equinox. Technically the Sun "enters the Sign of Libra," where it was in reality in 1322 B.C. The term is still used although the event now occurs in Virgo.

At 3.51 a.m. on the 24th about an hour and a half before Sunrise there will be a very close conjunction of Mars and Regulus, the first magnitude star in Leo, the distance between them being less than a degree.

A second conjunction of Saturn and the Moon will occur on the 30th at 5 a.m. about half an hour before they set.

Mercury rises at 7.17 a.m., 1 hour 10 minutes after the Sun, and sets at 7.39 p.m., 2 hours 2 minutes after it, on the 1st.; on the 15th it rises at 6.45 a.m., 55 minutes after the Sun, and sets at 7.35 p.m., 1 hour 41 minutes after it.

Venus rises at 7.2 a.m., 55 minutes after the Sun, and sets at 6.56 p.m., 1 hour 19 minutes after it, on the 1st; on the 15th it rises at 6.53 a.m., 1 hour 3 minutes after the Sun, and sets at 7.19 p.m., 1 hour 35 minutes after it.

Mars rises at 4.53 a.m., 1 hour 14 minutes before the Sun, and sets at 3.45 p.m., 1 hour 52 minutes before it, on the 1st; on the 15th it rises at 4.28 a.m., 1 hour 22 minutes before the Sun, and sets at 3.30 p.m., 2 hours 14 minutes before it.

Jupiter rises at 11.15 a.m. and sets at 1.1 a.m. on the 1st.; on the 15th it rises at 10.24 a.m. and sets at 12.12 a.m.

Saturn rises at 6.23 p.m. and sets at 6.55 a.m. on the 1st; on the 15th it rises at 5.22 p.m. and sets at 5.58 a.m.

7 Oct.,	☽	Last Quarter	10 28 p.m.
15 „	●	New Moon	8 20 p.m.
23 „	☾	First Quarter	10 53 p.m.
30 „	○	Full Moon	3 57 p.m.

Apogee, 16th October, at 6.30 p.m.
Perigee, 2nd October, at 1.2 a.m.
Perigee, 31st October, at 12.36 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

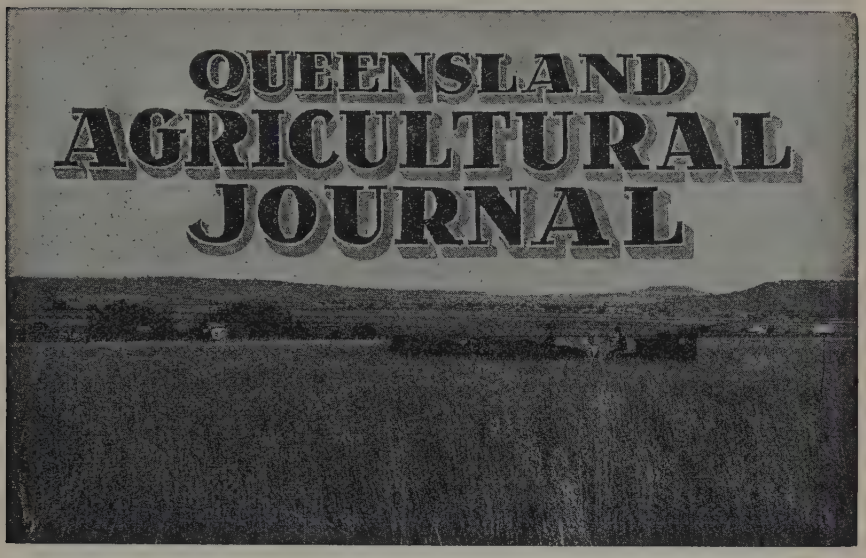
The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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VOL. XLVI. 1 OCTOBER, 1936. PART 4

Event and Comment

A Plea for the Tree.

SHELTER belts around a farm homestead serve a dual purpose. They increase the comfort of the dwelling, making it a much more pleasant place to live in, and also provide an attractive setting or background for the buildings. Such belts should not be planted too close to the house, as the trees would unduly shade the buildings during the winter months, possibly increase fire risks, and block tanks and drains with leaf litter.

Dealing with the subject on broad national grounds, to any plea for the tree may be added a plea for the development of a real forest conscience. Australians are often accused of a lack of that quality, and when the inevitable argument starts one is invited immediately to gaze on the landscape from a railway carriage window between any of our capital cities, without going further afield, where enormous tracts of country have been denuded ruthlessly by indiscriminate ring-barking and otherwise, of valuable indigenous forests. We once heard a lecturer advance the interesting theory that many Australian farmers and others have inherited a conscious or sub-conscious hatred of trees from their pioneer ancestors, who when they "invaded" Australia were faced with vast armies of trees. To prepare the ground for use they had to attack this enemy with a ruthlessness born of necessity, and now, when it is not only unnecessary but extremely harmful to the country, the same pitiless destruction goes on. "Farms," he said, "are seen standing naked, without a stick of timber to clothe them, and valuable forests are wiped out so as to provide relatively worthless

paddocks—that reference is, of course, to poor country where one blade of grass grows where two trees grew before.'' The lecturer hinted at a terrible vengeance which ''the spirits of the trees'' might one day exact from man for his violation of nature's laws.

Relation of Green Vegetation to Water Supply.

GREEN vegetation, we are told, is necessary to the composition of the very air we breathe and to the continuance of our water supplies. That idea might seem to us fantastic, but certainly without proper air and water we would perish quickly in a dry and choking atmosphere. However, the importance of tree life to the well-being of every country on this planet is not sufficiently understood. The influence of forests on the circulation of water on the earth's surface is also not yet fully understood. It is now claimed that land covered with grass or crops contributes through direct evaporation and through transpiration more vapour to the air than bare moist soils. Of all the vegetative coverings, a dense forest contributes most vapour. The French aptly call the forests the ''oceans of the continent,'' and compare the vapour given off by them to clouds of exhaust steam thrown into the atmosphere. Lowdermilk, in his recent investigations of the influence of the forest on rainfall, found that the increasing dryness of the interior of China is brought about by the decreased humidity of the air due to deforestation. This, together with the erosion following deforestation, has caused serious disturbance to the entire circulation of water in China. Whether forests actually increase rainfall may be still a question, but their influence on the distribution of rainfall over the land has a good foundation of scientific fact.

Trees and Soil Erosion.

THE preservation or replenishment of our forests has a definite bearing on one of the greatest problems that farmers, not only of Queensland or Australia but of every country, have to face—the problem of soil erosion. Every hill slope growing trees that hold back the soil, that blocks erosion, should be treasured and improved. Every timber reserve that holds back the bank of a winding stream should be maintained on sound forestry principles. The day may come when the streams may have to be straightened out, but always and for ever every bank should be protected from the action of flood waters by a fringe of good timber trees. Every pound of soil that goes down creek or river is so much loss. Facts may be stubborn, but they are a much more lasting foundation for success than individual fads. It has taken the Americans over 260 years to bring their vast forests to the verge of destruction, but Australians with the experience of the world before them have taken less than a century to bring their forests to the same condition of partial ruin.

Necessity of Forestry Reserves.

CONSTANT demands are being made to throw open forest reservations for settlement. Bearing in mind the small area of good land now available, and the keen competition for such good land for occupation, it is fairly certain that many of the existing reservations as they are denuded of timber supplies will have to be utilised for settlement. The proposal to make it compulsory that a certain area of all land under settlement must be reserved for forestry purposes is, therefore, wise and justifiable.

Parks, playgrounds, and recreational areas are a part of modern life. They could, in many instances, be improved and extended as national parks, and in time become a source of income, and at the same time furnish material for industry.

Every country town should consider seriously the possibilities and potentialities of a municipal timber reserve. It is not sufficient to confine activities to State school plantations. The need of wood for industrial purposes is already apparent, and the co-operation of all factors—town, country, State and nation—will only be effective when all realise to the full the urgent need for systematic forestry development and reafforestation. Facts concerning what to plant, when to plant, where to plant, and how to plant are obtainable. Accurate information is the basis of successful effort. That information is definitely available to every farmer interested, and on that information is based this plea for the tree.

The Problem of Prices.

A REASONABLE degree of stability in the prices of primary products is essential to national economic health. How is that stability to be attained and maintained? That is the question. It is not altogether unanswerable, and one obvious aspect of the answer is to improve our system of marketing. Effective marketing and distribution are twin problems facing the farmer to-day, not only confronting the farmer, but also the nation for a healthy and permanent agriculture is a fundamental condition of our survival as a nation.

Marketing is viewed, ordinarily, in the very narrow sense of selling what has been produced for sale. We have, however, to broaden that view to take in all the activities and organisation of handling, transporting, storing, processing, and manufacturing—the finding of ways and means of improving present marketing systems, the ultimate sale of products to the consumer.

The home market remains the farmer's best market, and between producer and consumer there is still too wide a gap, and that gap can only be reduced by better knowledge and stronger action by farmers organised along right lines and fortified with, at least, some understanding of the cold economic facts and extremely difficult problems with which their industry is beset. Intelligent and vigorous leadership —and this point cannot be stressed too strongly—is essential, and through it much loss of time, money, and misdirected energy can be avoided. The old slogan that competition is the life of trade contains a half-truth than which there is nothing more dangerous. Recent developments in the world commodity situation indicate that unrestrained competition might lead to the destruction of society as we know it, and have opened the eyes of the business world to the necessity of tempering a time-worn statement by the addition of one word and making it read "enlightened competition is the life of trade."

Stabilised prices and stabilised currency would give the farmer a fairer market deal. The fluctuations of both are among the chief causes of the farmer's economic difficulties.

Modern agriculture is very largely commercial. Farmers produce primarily for the market. The price basis on which they exchange their products is therefore a problem of prime importance. This problem of adjustment of production and marketing mechanism to ensure fair and reasonable prices to the producer calls for earnest study by all associated with rural industry.

Cat: M.L.

White Grub Damage to Pastures on the Atherton Tableland.

P.464.

J. HAROLD SMITH, M.Sc., Entomologist.

THE butter exported from the Atherton Tableland, an extensive tract of dairying country in North Queensland, is worth £300,000 to £400,000 per annum. This produce is derived from farms which have been established during the past thirty years; many of the most recently selected are only in partial use. Development on the individual property is comparatively slow for the indigenous rain forest has first to be felled and burned. Grass seeds are then sown in the residual ash, and the pasture is thus established contemporaneously with the disintegration of the logs and stumps which perforce litter the ground for some years. Permanent pastures supply almost all the feed requirements of the herd, though supplementary fodder crops are now receiving attention. Many of the older pastures show marked deterioration, and carrying capacities are generally declining. Under normal circumstances, improved farming practices should offset deterioration, and the industry would gradually evolve on mixed farming lines adequate to conserve the fertility of the soil at a suitably high level.

In the Malanda district pasture deterioration has taken place more rapidly than elsewhere. Climatic factors, important though these doubtless are in the tropics, do not completely explain the phenomenon in this district. Supplementary damage attributable to white grubs, the larvæ of a Scarabaeid beetle, *Lepidiota caudata* Blkb., makes the position of the farmer really critical. This pest has so weakened the pastures on numerous farms that during the dry winter and spring months the available feed is, in some years, below the normal maintenance requirements of the herd.

The species is indigenous to rain forest areas in North Queensland, and has previously attracted attention as an occasional pest of sugar cane in the Babinda district. The present investigations were centred on the Atherton Tableland, where the economic problem is quite distinct from that in the coastal sugar-cane areas.

Significance of the Pest.

The symptoms of white grub attacks in pasture lands are quite distinctive. The sward loses its normal green appearance during the late summer at focal points scattered here and there throughout the paddock. These areas gradually extend until larval development is completed, and by that time the bulk of the pasture may be worthless. A similar sward failure is also conspicuous along fence lines, and on the banks of the many gullies which cut through much of the land under consideration. The affected turf, when examined, can easily be removed to expose the numerous white grubs just beneath the surface. If the grub population is high, the turf may be completely destroyed.

Grub infested pastures quickly react to moisture deficiencies in the soil, and their appearance depends largely on the contemporary rainfall. If the rains are evenly distributed throughout the year, infested pastures may retain some vestige of life and recover rapidly when the pest ceases to feed at the end of larval development. Should continuous dry weather

coincide with the last few months of larval life, the grass may be almost entirely destroyed, and recovery is inevitably slow and is accompanied by a luxuriant weed growth.

Older paddocks usually suffer most severely. On many farms, the pastures range in age from five to 25 years, and the losses are confined to those which have been established more than 15 years. Paspalum, *P. dilatatum,* is the most important grass, but Kikuyu grass *Pennisetum clandestinum,* and Para grass, *Panicum muticum,* have also been introduced to the district. All three are subject to attack, though their recuperative powers differ somewhat when the larvæ have completed development, and weather conditions are favourable for recovery.

The destructive larval stages cover some eighteen to twenty months, but even the heaviest grub population makes little apparent impression in the pasture until the last of the three larval stages. The bulk of the root system is then destroyed, and the efficiency of the remainder seriously impaired by the soil disturbance inseparable from the activity of a grub population which moves freely in the soil. The failure of the turf to respond to good growing weather is the first sign of damage, and the symptoms become more and more acute until larval development is completed.

An incidental loss has frequently been noted. Farmers with grub-attacked paddocks may, when the damage has reached its peak, remove stock to facilitate natural recovery, renovate with implements, or crop the land with maize or some cereal for one or two years before regrassing. When the last-mentioned policy is adopted, the first year's crop is often valueless though yields in the second year are normal. The phenomenon will be discussed at a later stage in this paper.

The pest is also important from a health point of view. Many farmers and residents of small towns in the grub-infested areas procure their domestic water supplies from roof drainage collected and stored in tanks. During the flight season, countless numbers of the adult beetles are trapped in the spouting of the buildings and rot in situ. A contaminated water supply is thus a frequent cause of gastric troubles among the resident population.



Plate 191.
Last abdominal segment in *Lepidiota caudata* Blkb. Female on left; male on right.

Life History.

The parent beetle of the white grub is a large, cumbersome, dark brown insect about an inch in length. The sexes are superficially similar, but may be separated by the shape of the last abdominal segment, which, in the female, has a posterior projection absent from the other sex (Plate 191). Flight occurs during the spring and early summer months. Eggs are laid in the soil at a depth of a few inches in rather fragile earthen cells. These eggs hatch into small white grubs of typical Scarabaeid shape within three weeks, and are very common in pastures

during January, particularly in the vicinity of fallen trees and residual stumps. Growth proceeds steadily through the three larval instars, the first two of which require some twelve months for their completion. The larvæ enters the third and final instar early in its second year. Larval development is completed between July and September, when the grubs construct pupal chambers, which are normally situated at soil depths between one and two feet. Here transformation into the heavy-bodied pupa takes place within the limits of the earthen cell, and the adult beetle emerges during the spring months.

Before flight is possible, the adult must burrow through a considerable depth of soil, and its ability to do so is controlled by the texture of the overlying earth. At the end of the comparatively dry winter and spring months the soil may be almost impenetrable, and until soaked by the spring rains the beetles are unable to escape. Should the storm rains be insufficient to soften the ground down to the pupal chambers, the beetle mortality is considerable. The duration of the flight period and the intensity of the flight are thus subject to marked fluctuations. Early and copious rains which gradually introduce the monsoons induce moderate flights which may cover a considerable period, viz., October to January, the beetles emerging as soon as transformation is completed in the pupal chamber. A dry spring, in which storms are omitted from the climatic sequence until late November, causes mass emergence at a comparatively late date. The beetle population then on the wing includes vast numbers which have been cooped up in the soil unable to escape earlier together with recently transformed adults. Frequently the precipitation prior to late December is insufficient to penetrate the soil to pupation depths, and the pre-emergence mortality is then considerable.

Observations over a number of years indicate that the importance of the pest in any one season can be correlated with the intensity of the flight two years previously, a logical sequence of a two year life cycle, in which the larval injury to pastures is at a maximum in the second year of development.

Beetle Flight.

The beetle flight has several distinctive features. At dusk, adults emerge in vast numbers from the ground, and the flight increases in intensity until the air is literally teeming with insects. Adult movements are rapid, and, for some time at least, tend eastwards away from the setting sun. Wisconsin workers (Sweetmen, 1927 and 1931) studying an allied species of economic importance in that State, suggest that directional flights may be influenced by prevailing air currents, but in the case of L. caudata, no evidence favourable to this viewpoint has been obtained. The beetles fly directly to buildings, trees, charred stumps, and fence posts, and cling to the western side of any such obstacles on which mating, the primary object of the evening flight, takes place.

As more and more individuals are paired, the hum associated with the evening flight gradually diminishes, and within half an hour of its commencement few, if any, adults remain on the wing. At the completion of mating some of the beetles fly back to the open and presumably burrow into the pasture; quite a number remain on the trees, but the majority fall to the ground, and shelter in the soil below or near the tree, stump, or building on which mating has occurred.

A flight, if such it can be called, of another kind has been observed in the early morning. Before daybreak, trees on which mating has

occurred are clustered with adults, resting in a more or less torpid state on twigs and leaves. They loosen their hold at daybreak, and the majority drop directly to the ground, while a few fly strongly to the open. All remain underground until dusk when flight is again resumed. The morning flight is brief, and the sound of heavy-bodied insects falling through the foliage of the trees is reminiscent of a heavy hail storm.

Both sexes are equally numerous in the early part of the flight season, but later on there may be a distinct preponderance of females. These late season insects include freshly emerged adults with the purplish, elytral bloom intact, and weathered females from which the bloom has long since disappeared. It appears, therefore, that both sexes make nightly flights over a considerable period, polyandry on the part of the female and polygamy on the part of the male being normal for the species.

Though partial defoliation of some trees on which mating occurs is common, the damage is by no means serious in even the heaviest flight years. It is, therefore, inferred that the adults do not normally consume any considerable amount of food. Partial defoliation has been observed in the following trees:—Bloodwood (*Eucalyptus corymbosa*), grey teak (*Gmelina fasciculiflora*), northern silky oak (*Cardwellia sublimis*), fig wood (*Ficus Watkinsiana*), red tulip oak (*Tarrietia peralata*), Davidsonia plum (*Davidsonia pruriens*), Poinciana (*Poinciana regia*).

After the mating flight, most of the males and some of the females drop to the ground, and burrow under the surface, hence females are much more common than males in beetle series collected from trees at the conclusion of the evening flight. Yet, when the beetles are counted on the same trees before daybreak the following morning, both sexes are more or less equally represented. Again it is curious that while adults are numerous on stumps, fence posts, etc., during the mating flight, they have all disappeared before daybreak, when the insects are still quiescent on adjacent trees. Both observations suggest that there is some adult movement after the main business of mating. When or how this takes place is quite conjectural, but it is tentatively assumed that there is some slight post-mating migration to suitable host trees for feeding purposes.

White Grub Distribution on the Farm.

The flight as thus described sheds some light on the incidence of the pest on the farm. Pasture destruction frequently assumes its most acute phase near tree stumps and along fence lines. As these and similar obstacles are used by the adults to facilitate mating, vast numbers must burrow into the adjacent soil during the flight season. At least some of these will be sexually satiated, and lay eggs which will yield a considerable larval population. This inference can be confirmed in the field during January for first stage larvæ can then be collected in such situations with comparative ease. Infestation of this kind can thus be attributed to the place which stumps, fences, etc., occupy in the adult economy during the flight season.

Quite a considerable amount of damage occurs, however, in pastures which are quite free from stumps or trees which could be used by adults during mating. Such pastures typically show dead and dying areas unevenly scattered through the field, the intervening grass being quite green. These areas of damaged turf gradually extend owing to the lateral migration of the larvæ until each may cover an acre or more, and several may merge before larval development is completed.

The few reports of injury to crops cultivated on the Atherton Tableland all possess some special features worth recording. Cow cane, a common form of roughage grown in the district for winter and spring use, persists for a number of years. During the flight period, the crop may be five or six feet in height. Adults may be attracted to the crop when mating, and subsequently lay their eggs in the soil. The larvæ later attack the roots. A cropping system in which annuals are used would, of course, eliminate losses of this type, for eggs are not normally laid in land which is fallowed at the time of flight.

Frequently pastures harbouring second stage larvæ are ploughed and planted to maize. The pest, deprived of the grass roots on which it has hitherto fed, inevitably attacks the planted crop, and all the maize failures directly attributable to white grubs are of this type. Subsequent crops grown after the grub population has matured escape infestation.

The available data on the flight of the beetle readily explain pasture injury along fence lines and near trees or tree stumps, but cannot be linked up with injury in timber-free pastures, or the freedom from attack of cultivated land used for annual crops.

Pastures which have been grossly overstocked for some years often suffer most acutely from the pest, and it is sometimes inferred that turf characters influence oviposition. This view is held by workers on similar pests in Wisconsin, in the United States (Graber et al., 1931), where the inter-relationships of pasture composition and white grub infestation are receiving attention. Most of the pastures on the Atherton Tableland are pure stands of paspalum, but the quality of the sward varies with both the age of the pasture and the usage to which it has been subjected. Differences in the sward of a single paddock are thus due simply to the vagaries of stock feeding, an insufficient basis on which to postulate selective oviposition.

Yet the almost complete absence of white grub losses in land which is cropped annually implies selective oviposition. When gravid females are confined over bare soil in the laboratory, eggs are laid freely, and subsequent development is normal. The most reasonable explanation of the freedom of annually cropped lands from attack would thus be the assumption that gravid females prefer a vegetative cover when egg-laying. The relative attraction of the several different tyes of vegetative cover available in any one district are irrelevant to the freedom of cultivated annuals from attack though, perhaps, of interest as a possible explanation of localised grub development in a pasture.

If selective oviposition is omitted from consideration, it may be supposed that while oviposition is randomised, the turf type may modify both egglaying habits and the subsequent development of the larvæ. Both eggs and larvæ of some Scarabaeids are very susceptible to variations in soil temperatures and humidity, hence the natural mortality may be high (Pemberton, 1935). Randomised oviposition in the pasture may not, therefore, be followed by randomised larval development and coincident pasture destruction.

On purely observational data, it has been suggested (Buzacott, 1935) that the mass oviposition implied by the characteristic white grub injury to pastures may be due to an aggregation of adults in response to sound stimuli operating during flight. This thesis still lacks experimental warrant.

Spring Rainfall and the Seasonal Importance of the Pest.

The agricultural importance of the white grub pest varies from year to year though the area subject to infestation grows steadily larger—25,000 acres in 1935. The possible causes of this extension will be discussed later, but it is necessary to distinguish between soil and pasture characteristics, which control susceptibility to attack and the seasonal fluctuations in the numbers of the pest attributable to climatic and other causes. Of these climatic inhibitions, the most important concerns the effect of spring rains on adult emergence from the ground.

The life cycle of the pest covers some two years. Flights of variable intensity occur every spring, and the grub population in the soil comprises larvæ in all stages of development. Some of these larvæ are the progeny of females on the wing during the previous spring, but the larger forms are twelve months older and date back to an earlier flight. The year 1932 was, however, exceptionally dry during the spring months, and the beetles which should have emerged were almost completely killed below ground. As a consequence, flights in both 1932 and 1934 were negligible, and it will be some time before the pest will be of importance in even numbered years.

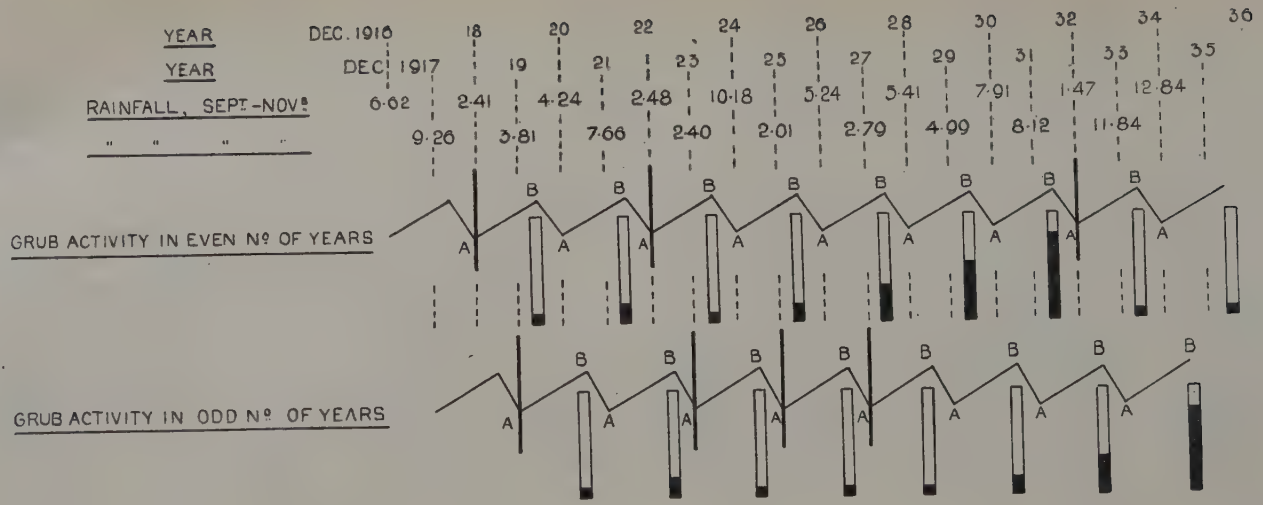
This striking demonstration of the beetle mortality attributable to a dry spring has prompted an analysis of the Malanda rainfall records for the past twenty years, in the hope that the available data on the spring rainfall would shed some light on the present position of the pest. The data is graphically displayed in Plate 2 to which reference should be made in the further discussion of the subject.

In North Queensland, spring is agriculturally an indefinite term, but for the present purpose may be defined from a consideration of the rainfall during the last six months of the year 1932, in which the most complete check to the pest so far recorded took place. These monthly rainfalls are as follows:—

July.	August.	September.	October.	November.	December.
1.70	3.17	0.48	0.65	0.34	10.17

Beetle emergence depends entirely on a prior soaking of the soil to pupation levels by rain and flight normally begins in October. In spite of fair winter rains, three months comparatively dry weather between September and early December were sufficient to almost completely inhibit beetle emergence. Hence when flight failure is attributed to insufficient rainfall during the spring months, the period, September to early December, is usually referred to. In 1932, the precipitation during this period was only 1.47 inches, and the beetle extermination was almost complete. The actual significance of spring rains to the pest will, of course, depend on their soaking properties, and the prior moisture content of the soil, one heavy fall being more advantageous to the pest than occasional light showers. Generalisations only are permissible at present, but for analytical purposes it may be assumed that when the spring rainfall, as defined above, falls below four inches, adult emergence will be inhibited to a greater or less extent.

Considering first the beetle series which normally flies in the spring of years with an even number (Plate 192), it will be noted that climatic checks to beetle flight occurred in the years 1918, 1922, and 1932. Prior to 1926 of the period under review, the grub population could scarcely



INFLUENCE OF SPRING RAINS ON WHITE GRUB ACTIVITY AND ADULT FLIGHT.

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Plate 192.

rise to pest proportions, but after that year, the status of the pest would steadily increase until the dry spring of 1932 practically exterminated the adult population. As would be expected, the available records indicate that, between 1926 and 1932, serious pasture injury occurred in the even numbered years.

In beetle flight years with an odd number (Plate 192) the position is rather different. Climatic checks were effective in 1919, 1923, 1925, and 1927. As a result, white grubs in this series had little agricultural significance until 1931. Heavy beetle flights in 1933 were studied for various reasons in connection with mating and other habits of the pest. The progeny of these beetles caused large scale pasture damage in 1935.

A number of important points can be deduced from the available data. These are:—

(*a*) Prior to 1928, the relative freedom of the Malanda district from white grub losses can be attributed, in part, at least, to the influence of dry springs in the years 1918, 1919, 1922, 1923, 1925, and 1927 on beetle emergence.

(*b*) Since 1928, the even year series, which had increased to alarming proportions, has since been checked by the dry spring of 1932, and should cause little trouble for some time.

(*c*) Since 1928, the odd year series has developed unhindered, and these insects are now a very serious worry.

(*d*) After a severe spring check, insects in either series require at least six years, i.e., three generations, to reach pest proportions once again. In the case of the even year series, the exceptional mortality in 1932 may possibly lengthen this period for no observed recovery took place in 1934.

It is interesting to notice that seasons which the farmer would consider favourable to dairying, i.e., seasons characterised by good spring rains, are equally favourable to the pest. Actually a dry spring serves dairying interests in the grub-susceptible belt much better by keeping the beetle population within manageable limits.

Natural Control.

As with most species, various natural enemies attack the several stages of the beetle now under consideration. Various Scoliid wasps attack Scarabaeid larvæ in the coastal districts, and probably show similar habits on the Atherton Tableland. The commonest species is *Campsomeris tasmaniensis* Sauss. These insects have not as yet proved an efficient check on Scarabaeid activity in Queensland, and *Bombylid* hyperparasites are probably the limiting factor to their utility.

Tachnid larvæ have often been dissected from moribund adults handled in the laboratory, and from them flies, as yet unnamed, have been reared. This parasite is quite unable to keep the pest in check, and it seems that effective parasitism is at present negligible.

The grub-infested parts of a paddock are often pitted with holes excavated by bandicoots (*Parameles spp.*). These usually attract attention during the later phases of larval life, and, though indicating carnivorous habits in the animal, hardly permit the inference that bandicoots materially assist in the control of the pest.

Two birds, the straw necked ibis (*Threskiornis spinicollis*) and the native companion (*Megalornis rubicundis*) are particularly fond of white grubs, and conspicuously forage through pastures in search of them. The former is perhaps the more important, chiefly because it is the more numerous species. Both birds are of value only towards the end of the larval period, but their numbers are quite insufficient to appreciably affect the pest position. They usually appear in pastures when the damage has almost reached its peak, for the birds can then easily penetrate the turf when searching for white grubs.

The Significance of Soil Characters to the Pest.

The grub-infested district forms part of the much larger Atherton Tableland, situated some 2,500 feet above sea level. The soils are grouped as tropical red earths, representatives of which are by no means common in Australia. The source rock is basaltic for the most part, though schistose outcrops are common towards the coastal range. Volcanic activity was apparently widespread in the locality during Tertiary times (David, 1932), and several explosion craters occur in the white grub-infested country. Though superficially similar, the red earths fall into two distinct types, confined to specific districts, and separable on acidity values, one being neutral or alkaline, while the other is very acid. It may be noted here that the most acid soils on the Tableland are located in the grub-infested districts.

The contour of the country varies a great deal. Towards Atherton, farms are located on undulating country, much of which can be conveniently ploughed. Towards the coastal range, the rainfall is heavier, and prolonged erosion has produced quite a rugged contour, which is greatest towards Millaa Millaa. Similar features characterise many farms on the outskirts of the present settled area adjacent to the forest reserves, which clothe the main coastal range. Farms in the grub-infested zone are of an intermediate type, and much of the country could be ploughed without serious risk of erosion, though many of the paddocks are unsuitable for permanent cultivation.

The dominent basaltic soils are red to chocolate in colour, and usually lack any distinctive profile. In spite of a high clay content, 40 per cent. to 60 per cent., they are permeable loams, the friability of which may be due to the flocculating effect of free ferric hydroxide (Prescott, 1931). In the wetter parts of the Tableland, the soil depth is very variable. Colour values grade from red, through brown to yellow, and even grey. The significance of erosion and leaching in creating the present facies is amply demonstrated by the sequence of soil colours down the length of a hill, the darker shades capping the summit, and grading into lighter shades towards the gullies. The shallower soils may possess a profile. Deposits of greyish podsolic types of soil may be built up at creek bends by material derived from the coastal range.

The whole of the Tableland, apart from sclerophyllous forest areas of limited extent, was originally clothed with luxuriant rain forest. The destruction of the timber as a preliminary to closer settlement has destroyed a most powerful brake on erosion, the harmful effects of which are better appreciated now than hitherto. Gullies are widening to claim a greater part of the original paddock, and sheet erosion in cultivated areas is a constant danger during the wet season.

Grub Distribution in Relation to Acidity and Humus Values in the Soil.

Various entomologists interested in Scarabaeids have previously suggested a correlation between pH values of the soil and white grub distribution (Christensen, 1933). No uniformly applicable conclusion has yet been reached on the subject, and, indeed, generalisations would be difficult to establish with such a wide range of species, many of which show distinct ecological requirements. On the Atherton Tableland, two species, *L. caudata* and *L. lævis* Arrow, infest separate localities, which are superficially similar, the former near Malanda, the latter at Atherton. Though *L. caudata* is slowly extending its domain, *L. lævis* has persisted on four or five farms for many years, and shows no signs of spreading. Clearly some factor or factors capable of elucidation must determine their distribution. Soil differences are the most promising field for investigation, and preliminary studies of Tableland soils have shed some light on the distribution of *L. caudata,* the species with which this paper is chiefly concerned.

Soil samples have been collected, both within and outside the grub-infested area, for the determination of humus content and pH values. When rain forest is first cleared, preparatory to grassing, vast reserves of organic matter have accumulated in the soil, and these are primarily responsible for the lush growth and consequent high carrying capacities of pastures when first established in the tropics. High temperatures, however, rapidly mineralise the organic matter, and pasture deterioration takes place. The humus content of the soil in grub-infested districts is generally good, being approximately 3 per cent. in soil dried at 100 degrees C., but the activity of the pest shows no parallelism with the several available humus determinations. It would appear, therefore, that the humus content can scarcely be a controlling factor in the distribution of white grubs, though it doubtless plays an important part in maintaining growth in infested pastures, and in stimulating regrowth once infestation has come to an end.

The implications of acidity values in the soil yield more suggestive results. Soil samples have been collected over the whole of the Tableland, and the trend of acidity values in and near the grub-infested areas is shown on the accompanying sketch (Plate 193), which also indicates the area attacked in 1935. The available data suggests conclusions which, though tentative only, are accepted for purposes of discussion.

In the first place, it should be noted that grub susceptible soils are usually more acid than those not subject to infestation. Typical pH values may be set out for comparison as follows:—

Within the grub-infested area:—

5.29; 5.4; 5.57; 5.95; 5.25; 5.94; 5.3; 5.51; 5.17; 5.36.

Outside the grub-infested area:—

7.49; 7.2; 7.09; 5.74 (*a*); 6.15; 6.1; 5.7 (*b*); 5.83 (*b*); 5.73 (*b*); 6.03; 6.3.

(*a*) The farm from which this sample was taken is unique in the locality as white grubs have, on one occasion, caused some loss during the past decade.

(*b*) These properties lie close to the present southern boundary of the area infested in 1935. A recent spread in that direction has to be recorded.

The acidity of soils in the grub-infested area is uniformly high, and it may be inferred from the available data that soils with a pH value in the vicinity of 5.5 or under are liable to infestation.

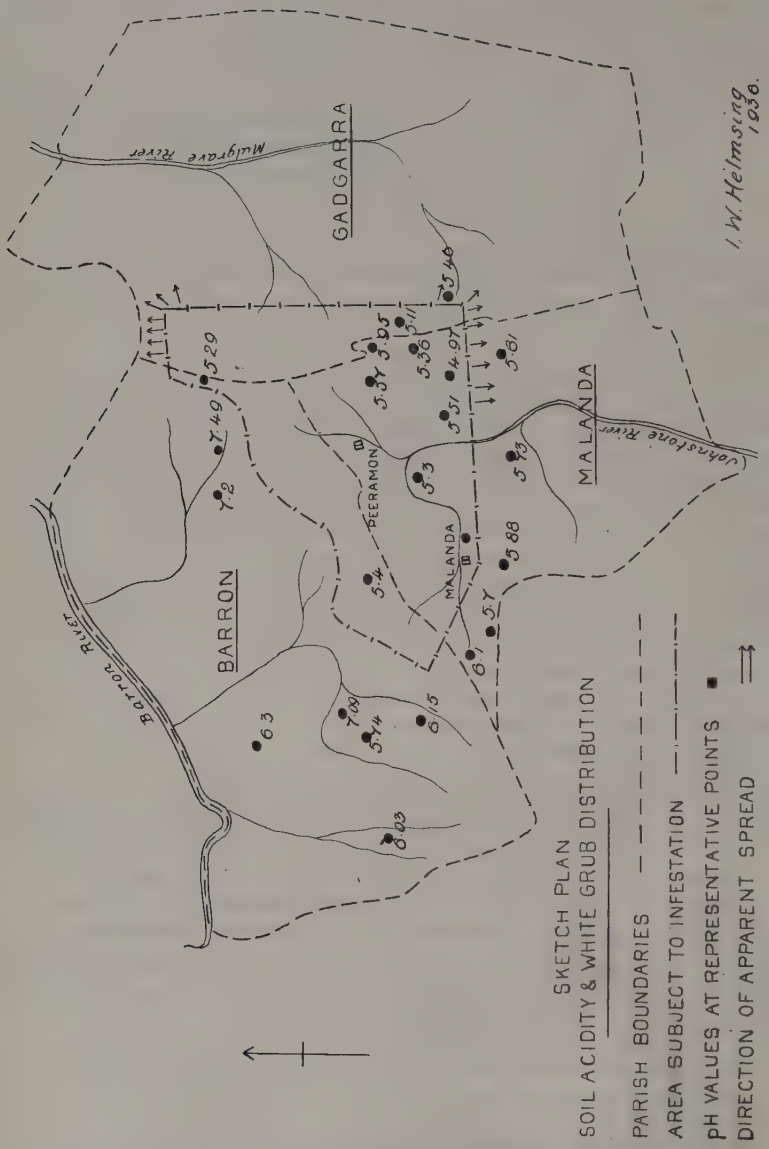


Plate 193.

The western and north-western boundaries of the infested area have been more or less stable since observations commenced some years ago. These boundaries front the Barron watershed, soils in which are more or less neutral. The difference in acidity determinations between soils from the Barron watershed on the one hand, and the Johnstone and Mulgrave watersheds on the other, though perhaps partly attributable to disparate rainfalls, probably reflects the rock type from which each is derived. The contrast between the two soils can be illustrated by reference to a purely agricultural point. Lucerne thrives best in an

alkaline soil, both the duration of the stand and the yield diminishing under acid soil conditions. The crop can be successfully grown on most of the country watered by the river Barron, but attempts to use the crop in the grub-infested districts have been uniformly unsuccessful. One may thus legitimately infer from the data that the relatively alkaline soils of the Barron watershed may be responsible for the stability of the western and north-western boundaries of the grub-infested area.

Soils just outside the grub-infested area on the southern and northerly boundaries are rather less acid than those within its limits, but the difference in acidity levels is less marked than on the western and north-western grub-free soils. It is interesting to note that some extension of the infested area to the north and south in the vicinity of the coastal range has taken place during recent years. These areas are in a heavy rainfall belt, and soils would tend to become more and more acid through the leaching processes to which they are subject, soil bases being removed in considerable quantities during the wet summer months. At present, these soils possess acidity values approaching the critical pH 5·5 level, below which possible grub infestation is inferred. A further extension of the grub susceptible area can therefore be expected if the acidity thesis is correct. In the absence of authentic data on the annual depletion of available bases from the soil, estimates of the rate of spread can scarcely be offered, and they would, in any case, by subject to marked fluctuations with the seasonal numbers of the pest.

Acidity is a measure of the base un-saturation of the soil, and, as calcium accounts for some 80 per cent. of the reaction value of these bases, deficiencies in this element can be correlated with acidity for ordinary purposes. Aluminium compounds may also influence acidity, but an excess of these is usually indicated by toxic effects in the vegetative cover. The significance of lime deficiencies alone are considered here.

Soils are often grouped into crumb structure and single grain structure types, individual soil particles being held together in the former by soil colloids, which are deficient in the latter. Crumb structure soils are best suited for general agricultural purposes, as they facilitate cultural operations and conserve the moisture necessary for plant requirements. A steady loss of lime through leaching and other causes may degrade a crumb structure soil to inferior types, but the desired texture may often be restored by the addition of supplementary supplies of quicklime, rock lime, &c. The soils in the grub-infested area are by no means physically poor at present, but there is some evidence to suggest that physical characters are deteriorating.

Again, as the clay content of these soils is exceptionally high, alterations in the clay complex may follow lime attrition. Changes of this type will inevitably show up in an altered soil texture, and may have some bearing on the suitability of acid soils for the development of white grubs.

In some parts of the world, definite correlations have been established between soil texture and the susceptibility of a soil to white grub infestation. These correlations may be, as in Hawaii, not only susceptible to chemical analysis, but can, in some instances, be detected in the field by direct observation. Such clear-cut distinctions between susceptible and non-susceptible soils cannot, as yet, be formulated for the Atherton Tableland. But the existence of such correlations in some Scarabaeids suggest that the localisation of the Malanda species to the more acid soils

may not be due to acidity *per se,* but to alterations in soil texture associated with the drift in lime values. The significance of such changes should be a profitable field for further study.

Soil Capillarity in Relation to White Grub Infestation.

Temporary changes of another type are frequently detected in land which has been infested with white grubs. When damaged paddocks are ploughed, they may be allowed to revert immediately to grass or a crop of maize may be harvested before pasture re-establishment is attempted. In those parts of the paddock where grub injury has been most pronounced, the initial maize crop may be a failure, or alternatively pasture recovery is surprisingly slow. Analyses of representative soils indicate that capillary values have been seriously disturbed in these areas.

In a paddock allowed to revert to grass after a single ploughing in 1932, capillary values in normal and sub-normal recovered areas were:—

	3 hours.	6 hours.	24 hours.	48 hours.
Sub-normal recovery ..	2½in.	3½in.	4¾in.	6in.
Normal recovery	5¾in.	7in.	9½in.	10¾in.

On a second farm, the samples were taken from an existing grub attacked paddock, and an adjacent one, in which an initial crop failure was recorded two years previously:—

	3 hours.	6 hours.	24 hours.	48 hours.
Grub attack pasture ..	6½in.	7½in.	8½in	9in.
Cropped paddock	8½in.	9½in.	10¼in.	11½in.

From both sets of figures, it would appear that the capillarity of soils which have been infested with white grubs has been depressed.

Owing to the high permeability of soils on the Atherton Tableland, plant growth is almost entirely dependant on the precipitation moisture retained by the upper layers of the soil. Even the small amount of the total rainfall held by the soil is subject to rapid depletion, for surface temperatures may be high and evaporation considerable. An ideal cropping season thus presupposes intermittent rains at fairly short intervals during the growing period. Alterations in soil capillarity induced by the white grub population indicate a marked disturbance in the moisture holding capacity of the soil, a defect which may be responsible for the adverse showing of either pasture or crops grown on recently ploughed grub-infested soils during a difficult season.

The mechanism by which white grubs influence soil capillarity is uncertain. Normally the larvæ move freely in the soil in sympathy with changes in the moisture levels during the year. In saturated soils, the grubs are close to the surface, but during persistent dry weather, they pass to greater depths. The mechanical disturbance of the soil caused through the movements of the comparatively large-bodied larvæ may be sufficient to upset normal capillary values, but another factor probably comes into play. The larvæ habitually ingest considerable quantities of soil and, when heavily infested, the soil may show "pellet" characters. Alterations in capillary values may well be associated with the phenomenon.

A single wet season is usually sufficient to restore the capillarity to more or less customary levels.

Control Measures for White Grubs.

White grubs are well-known pests in Queensland, and cause considerable damage to some of the sugar-cane crops grown in the coastal areas of the State (Illingworth and Dodd, 1921). Fumigation has frequently been recommended for the control of these pests (E. Jarvis, 1925).

In pasture land fumigation for white grubs is quite impracticable, for, no matter whether carbon bisulphide, paradichlorobenzene, or a mixture of these is used, the expense entailed would be prohibitive to the dairy farmer. Even were suitable methods of applying the fumigants to pastures available, the outlay would only be justified if the treatment endured immunity from further attacks for a number of years. The habits of the insect preclude this, and the utility of fumigation and similar methods of control can, therefore, be omitted from further discussion.

Trapping Measures.

During the flight season, vast numbers of adults cluster round houses in the grub-infested districts. In view of this obvious attraction to buildings, it is not surprising that suitably designed lights have been proposed as a means of trapping the adults. The suggestion is, however, based on a misinterpretation of a distinctive habit. Lights in the home are not the primary attraction to the beetle. Comparable numbers may be found in and around outbuildings, or at trees and stumps. Homes attract the beetles in precisely the same way as any other upright structure, i.e., because they provide adequate support for mating purposes. The common belief that lights do attract the insect was, however, checked during the flight of 1933.

Acetylene lamps were placed in the middle of trays some three feet square, each of which held water to which a little kerosene had been added. Beetles attracted to the lights ultimately fall into the water, and are held there until the following morning. All lights were lit just before dusk, and allowed to burn for a period of three or four hours. At one station, lights were placed in a grub-infested pasture near a clump of trees to which beetles were obviously attracted during the mating flight. From the two trays in use, 136 beetles were collected, the catch including more males than females. On a second occasion, the lights were placed near a deserted homestead. Three hundred and forty-four adults were taken in the two trays, again with a preponderance of males.

When related to the intensity of the flight, the numbers caught were quite negligible. Far more beetles were obtained from both trees and stumps by hand collection of the mating groups in a very short time. Hence, were trapping seriously considered as a control measure, methods more efficient than light traps could easily be devised.

Houses, unfortunately for the residents, form excellent traps, for many adults strike the galvanised iron roof during the mating flight and gravitate to the spouting from which they are unable to escape. In a heavy flight year, the spouting must be cleaned every two or three days, and literally thousands of dead and dying insects are removed on each occasion. The frequent contamination of tank water used for drinking purposes is positively dangerous, and gastric ailments are apt to be very common in the Malanda district. The collection and destruction of insects in and around houses is therefore a necessary trapping measure, which must be carried out as a reasonable health precaution.

The method could, perhaps, be extended by collecting adults under the principal feeding and mating trees. At the conclusion of the evening flight, and again at daybreak, vast numbers simply drop to the ground and burrow under cover. These may be conveniently collected and subsequently destroyed. On most farms in the grub-infested districts, the large number of stumps and logs scattered through the pastures lessens the value of systematic trapping, for, no matter how conscientiously carried out, it is almost impossible to concentrate on all the focal points at which the beetles congregate in the short time at the operators' disposal.

Better results should be obtained by running pigs in adequate numbers through the paddocks during the flight season. Pigs depastured at that time of the year quickly locate beetles sheltering in the soil, and destroy vast numbers of the pest. The beetles are relished by the pigs, and their accessibility diminishes the tendency of the animals to wander. Fencing difficulties are consequently less acute than usual. The further extension of the practice is therefore to be commended.

The Utility of Renovation.

When a grass paddock has been severely infested with white grubs, the stock must be removed and grazed elsewhere. If the pasture is left undisturbed, sufficient roots may survive to re-establish the sward when the spring and summer rains once again stimulate growth. The response is often surprisingly good, and it appears that the pest removes the root-bound condition which hampers growth in so many old paspalum pastures. In prolonged dry weather, root destruction may be carried too far, and the naturally re-established sward is by no means complete. As paspalum does not spread by means of runners, supplementary seed must be sown to regrass the bare patches or alternatively, the pasture may be managed to facilitate natural seeding. In the latter case, the paddock is closed to stock until seeding takes place, usually in March or April. Light harrows then provide the necessary cover for the seed and stocking may be restocked, though the pasture should only be lightly grazed until the sward is completely re-established.

Incidental renovation without the use of implements is effected when "hogging off" is practised. Most farmers keep a few pigs as a profitable outlet for skimmed milk and other by-products of the farm, and the pigs are often allowed access to infested paddocks where they root up the damaged turf in the search for larvæ. If sufficient pigs are available, almost the whole of the infested pasture will be broken up and, should growing weather supervene, the grass grows vigorously owing to the joint effects of renovation and white grub destruction. Not infrequently, however, pigs have been depastured during the relatively dry winter and spring months with definitely harmful results. It would thus appear that while pigs may be very useful during the spring flight as a means of exterminating the beetles and during the summer months when the grub population is high, some risk is inseparable from "hogging off" unless normal seasonal conditions guarantee rapid re-establishment of the pasture—i.e., "hogging off" can be safely adopted only during late spring and summer.

Renovation in either of the above ways is perhaps the simplest method of handling pastures attacked by white grubs. The resultant improved quality of the sward indicates that renovation on more systematic lines would be profitable. Many Tableland pastures do not

yield an adequate body of feed, growth being depressed by a matted root system which interferes with the aeration and water relationships of the soil in the root occupied zone.

Ordinary renovation presumes the use of implements capable of remedying the root-bound condition in a pasture. Ploughing adequately serves the purpose, and pastures treated in good growing weather subsequently carry an excellent body of healthy grass. The operation must, however, be accurately timed to give the best results, for there are cases on record in which indiscriminate ploughing has been definitely injurious. Ploughing exposes both dead and living roots, and the re-establishment of the pasture depends on the latter striking root again. If the land is turned over in dry weather and adverse conditions persist for any length of time, many of the living roots are destroyed and pasture recovery is incomplete. Ordinarily the consequences of ill-timed ploughing may be serious enough, but in grub-infested areas the few roots which in good weather would be sufficient to re-establish a new pasture may be almost completely destroyed. Reseeding will then be necessary. Grub infestation is rarely severe enough to hinder pasture re-establishment in good growing weather though the appearance of the sward may be spoiled for a time by a prolific weed growth. These are of little direct importance for vigorously-growing paspalum quickly smothers incidental growth of this kind. Ploughing should, therefore, be restricted to the late spring and early summer months when adequate rains are assured.

Pastures growing under the stimulus of cultural operations are more resistant to the ravages of the pest than others which have been untreated in any way. If the land harbours a considerable population of second-stage grubs, cultural disturbance of the soil interferes very little with their development and the larvæ subsequently attack the renovated pasture. This difficulty can be largely overcome by restricting cultural renovation in the grub susceptible belt to the late spring or early summer in which flight is anticipated. The grub population has then completed its destructive phase, the treated paddocks are more or less in a fallow condition during the flight and the beetles should lay their eggs elsewhere. The reinfestation of pastures renovated in this way is thus obviated for some time, though still possible in a subsequent flight.

Disc ploughs are in common use on the Atherton Tableland, and admirable though their work may be in permanent cultivation their value for pasture renovation is a very moot point. The matted turf is thrown in all directions, the discs are very liable to "ride" parts of the pasture and the whole paddock is left in a very rough state. On slopes, this may be a serious disadvantage for erosion after heavy rain is facilitated. Better results should follow the systematic use of the mouldboard plough even though the draught is heavier and the work somewhat slower. Mouldboard ploughing shows the following advantages:—

(*a*) The turf is completely turned over and finally produces an even pasture free from the irregularities inseparable from disc ploughing in grass land;

(*b*) The harrowing which should normally follow the ploughing is more thoroughly carried out;

(*c*) The combined effect of (*a*) and (*b*) is such that, during the flight season, the surface has a cultivated fallow appearance and oviposition should not normally occur.

Another possible procedure requires the insertion of a cropping system between ploughing and pasture re-establishment. So far, this method of attacking the problem has not received any considerable attention. This may be due to the limited range of crops which can be profitably grown on the Atherton Tableland, the common failure of a first crop planted in previously grub-infested paddocks, and finally to the widespread reluctance of farmers to embark on a mixed farming project involving the feeding of stock during the winter months.

Grassland farming in which farmers rely almost wholly on either native or introduced grasses for the feed requirements of their stock is a more or less elementary method of managing a property. Intermittent rains are necessary to ensure a continuous supply of fodder, and without them the farm merely passes from one shortage to another with intervening surpluses. In North Queensland the pastures are invariably parched during the winter and spring months, and a fodder crisis is an almost annually recurring event on many properties. For ordinary purposes, complete dependence on permanent pastures can only be justified in the early stages of development and must sooner or later give way to farming systems which incorporate both permanent pastures and a certain amount of tillage.

In the grub-infested areas the need for some such alteration is perhaps more urgent than elsewhere in North Queensland, for a cultivation unit attached to the farm ensures a supply of feed when grub activity has played havoc with the pastures. Improvements in pasture management involving the subdivision of paddocks to permit rotational grazing and the elimination of overstocking, a common evil, will doubtless improve matters, but in themselves are insufficient to make farming profitable.

Cultivation in the wetter parts of the tropics introduces a number of problems, the chief of which is the susceptibility of the soil to erosion. In rugged country this difficulty is almost insuperable, but in most areas where cultivation now requires attention, the surface is more or less undulating with moderate gradients. The risk of soil erosion could, in this type of country, be minimised by the systematic adoption of contour drains, the value of which is, as yet, insufficiently appreciated.

In any mixed farming project suitable for the Atherton Tableland, certain fundamental features will require attention. Some of these are:—

(*a*) The subdivision of existing pastures to acreages not exceeding 15, though smaller paddocks could advantageously be used in many instances. Relatively small pastures both permit rotational grazing and facilitate the insertion of a cultivated crop into the programme when renovation becomes necessary.

(*b*) The movement of tillage operations round the property so that most of the paddocks would periodically be brought under the plough. Thus in any one paddock systematic cropping would precede the establishment of a pasture which would, in turn, revert to the plough as soon as deterioration became apparent.

(*c*) The provision of storage facilities on the farm in the form of silos, &c., to ensure that crop wastage due to the deterioration of any surplus over immediate feed requirements would be eliminated. Climatic conditions are generally unfavourable for fodder conservation as hay.

(*d*) The introduction of a variety of crops suitable for compounding rations which can be balanced at all times of the year.

Immediate improvements can be suggested on most farms, but the best method of utilising areas under cultivation is still in doubt. Normally the summer rains are assured on the Atherton Tableland, and there is consequently little difficulty in procuring adequate feed for the herd during the summer months from permanent pastures. The provision of winter feeds is more difficult for the late summer and winter rains needed for the seeding and establishment of suitable cereals are often problematical. Present farming systems assume a fodder shortage during the winter and spring months and cows are brought to the bale in spring and summer to ensure the maximum flow of milk when food supplies are adequate. Under existing methods, this is perhaps the only way to manage a herd, but it can hardly be considered a desirable permanent agricultural practice. In short, dairying methods are dictated at present by the availability of fodder supplies in a grazing system. Further progress presupposes some cultivation, and the provision of sufficient fodder reserves to keep the herd in profitable production for the whole twelve months.

Pasture Management in Relation to White Grub Activity.

Various observations during recent years suggest that the condition of the pasture has much to do with white grub infestation in the susceptible area. The relative immunity of young pastures from attack has already been mentioned and the turf in these is invariably much better than that in older pastures where attacks are normally expected. Pastures within the grub-infested areas which, for various reasons, have not been intensively grazed also appear to escape severe attacks while hillsides usually suffer more acutely than flats favoured with seepage water. The position thus shows some slight similarity to that recorded for the white grub, *Phyllophaga sp.* in Wisconsin, where intensive studies of agricultural methods of control have been carried out for some years (Christensen, 1934).

At Wisconsin suitable methods of pasture management and improvement are tolerably well understood as a result of long term experimental work. Mixed pastures of grasses and legumes can be established and maintained without any great difficulty, while both organic and mineral fertilizers appreciably affect both the quality of the turf and the fodder yield from it.

On the Atherton Tableland methods of pasture management and the response of pastures to manures have not yet received detailed attention. Nevertheless it is commonly supposed that tropical red earths of the Tableland type do not respond adequately to fertilizers unless they are applied in uneconomic quantities. This supposition can scarcely be accepted as final when pastures show obvious signs of deterioration and the subject merits further study in both the field and the laboratory. The relationship of sward types to white grub susceptibility should be better understood when results of recently initiated pasture improvement work are available.

Modifications in pasture types also require consideration. Clovers cannot be successfully grown except in the wetter parts of the Tableland and in particularly favoured seepage soils. Other legumes have similarly proved unsatisfactory. Grasses of various types are in use. Paspalum, *P. dilatatum,* a summer-growing perennial, is the most important, but many of the older paddocks are being invaded by the much inferior species *Axonopus compressus* and *Paspalum conjugatum.* Kikuyu grass, *Pennisetum clandestinum,* grows more vigorously than paspalum but appears to exhaust the soil much more quickly than other grasses of value to the farmer. Its dominant habit, moreover, is such that other species are smothered out in a comparatively short time. Rhodes grass *Chloris gayana,* and Para grass, *Panicum muticum,* play minor roles in Tableland pastures and are best suited to restricted areas with soil and drainage characteristics which are not general to the district. At present it appears that permanent mixed pastures containing a number of selected grasses and legumes are scarcely attainable in the immediate future. It may, however, be practicable to control the turf type to some extent by various methods of stock management and the application of manures.

The difficulty of controlling pasture composition adds further point to the importance of the cultivated area on the farm. There alone can the cropping system be manipulated to supplement the available pasturage. Thus while pastures may contain pure stands of paspalum as summer feed, the cultivation area alone permits the discriminate use of the ground for the growth of crops which will both add to the limited winter pasturage and narrow down the ration balance to desirable levels.

How far the practicable control of herbage types may influence the susceptibility of pastures to white grub attacks is a moot point, but it would perhaps be unwise to expect results comparable to those secured at Wisconsin. This viewpoint is based solely on the greater difficulty of altering the constituent flora in the pasture by manurial and grazing methods.

Summary and Conclusions.

1. The Scarabaeid, *Lepidiota caudata* Blkb., has been a serious pest of pastures in the Malanda district for some years. The pasture deterioration due to this and other causes is now so pronounced in that area that dairying under present methods is scarcely profitable.

2. Flight takes place during the spring when the storms which usher in the monsoonal rains have penetrated to pupal depths in the soil. Flight habits are described in some detail, especially in so far as they concern oviposition and the subsequent incidence of white grub damage. Development requires two years and pasture destruction usually becomes acute during the second year of larval life. It is thus possible to forecast more or less accurately the probable damage in any year by referring to the intensity of previous flights.

3. The only known natural check on the pest is a climatic one—viz., a dry spring which prevents the beetles emerging from the ground at the completion of their development. A dry spring may, as in 1932, almost completely exterminate the generation which is due to fly. The present importance of the pest can be attributed to a succession of wet springs in odd numbered years—1929-31-33—in which conditions have been entirely favourable to the pest. Prior to 1927 dry springs were a common phenomenon on the Atherton Tableland and the pest was thus kept within reasonable limits.

4. White grub activity, due to *L. caudata*, is confined to the most acid soils on the Atherton Tableland. Acidity probably reflects the magma types from which these soils were derived, but will become intensified by the leaching to which they are subject. On these premises it is inferred that the area subject to attack will gradually extend, particularly in the vicinity of the coastal range where the rainfall is heaviest.

5. The common failure of previously grub-infested land to crop well during its first year under the plough is invariably due to prior grub interference with soil moisture relationship. An interval of twelve months or so elapses before the return to normal.

6. Measures which prove useful for the control of white grubs in the sugar-cane growing areas of the State are far too expensive for Tableland purposes. In any case, they cannot give permanent relief to the farmer. Better results should accrue from alterations in current agricultural practices which will lessen the risk of the farmer being completely at the mercy of the pest, as is inevitable under purely grazing methods of maintaining a herd. Suggested alterations include fodder conservation for use when grazing reserves are depleted, better pasture management with the aid of rotational grazing and lighter stocking with grade cattle.

7. In any mixed farming system suitable for general adoption in the white grub-infested areas, entomological considerations must influence its major features. The more important of these are:—

(*a*) The practicability of forecasting white grub losses permits the farmer in normal seasons to accumulate reserves for any anticipated fodder shortage. Such reserves would include carry-over roughage, cow cane, winter cereals of approved varieties, and ensilage. The area necessary for the cultivated crops under the proposed scheme requires more tillage than is at present usual and farmers should aim at an allowance of 20 acres per farm. The cultivation areas should, if contours permit, move round the farm so that any given paddock comes under the plough at least once in every ten or fifteen years.

(*b*) Eggs are rarely laid in fallow ground, hence grass paddocks should be broken up early in the flight season—i.e., during the spring storms. If the paddock is ploughed in late summer or autumn, the grub population is already established and will attack any crops subsequently planted so matter how well the land may be worked. Hence should the beetle flight in any year presage heavy pasture damage eighteen months later, a suitable area on which fodder reserves can be grown should be brought under cultivation as soon as the intensity of the flight can be estimated.

(*c*) Normally disc ploughs are used for breaking up pastures, no matter whether renovation or tillage is the aim of the farmer. It should be noted that the mouldboard plough is much more suitable for pasture renovation than the ubiquitous disc type, particularly in grub-infested districts, for the more complete soil cover obtained acts as a deterrent to egg-laying. The heavier draught of the mouldboard plough is more than compensated for by the better work done.

(*d*) "Hogging off" should be confined to the late spring and summer months when good growing conditions are assured. Pigs can be very useful during the beetle flight period when they consume immense numbers concealed in the soil between successive flights. During the summer grubs are consumed. The incidental rooting up of the turf is quite beneficial to the pasture during the wetter months of the year, the effect being comparable to renovation with implements. "Hogging off" during the dry winter months may be harmful for, in the absence of rain the disturbed roots fail to strike root and pasture recovery is consequently delayed.

8. Most of the pastures consist of pure stands of either paspalum or kikuyu grass. The control of pasture types presents singular difficulties and it is improbable that white grub infestation can be influenced by such means in the near future.

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ADDENDUM.

White Grub Injury in Pastures Elsewhere in Queensland.

Though *Lepidiota caudata* Blkb., the subject of this article, is beyond question the most destructive pasture species in the State, sporadic outbreaks of other Scarabaeids are quite common. One of these, *Lepidiota laevis* Arrow, has been mentioned already, for it has a restricted range on the Atherton Tableland and causes a great deal of confusion to the farmer who is invariably more familiar with the tolerably similar larvæ than with the quite distinct adult beetles.

All the economically important pasture species are found in friable red or chocolate loams which originally carried a typical rain forest flora, the constituent elements in which varied with latitude, rainfall, and other relevant factors. The Scarabaeid species involved in the recorded outbreaks show a like diversity and the identity of some is still uncertain.

The more significant features of recent outbreaks may be noted.

A light-brown species, *Lepidiota laevis* Arrow, is restricted to a small area of alkaline soil in the vicinity of Atherton and is as destructive within its limits as the more important *L. caudata*. Unlike the latter species the adults are strongly phototropic and immense numbers can be trapped at lights. Apparently the insect has rather specialised ecological requirements for, though known some twenty years, there has been no spread of the pest other than minor seasonal fluctuations associated with the climatically controlled ebb and flow in adult emergence. As in *L. caudata* the life cycle covers two years.

The Childers sugar-cane beetle, *Pseudoholophylla furfuracea* Burm., has been recorded as attacking pastures. Childers is essentially a sugar-cane producing area and *P. furfuracea* is the most important of the Scarabaeids attacking the crop. Pasture injury in the vicinity of sugar-cane is unusual but can be understood by reference to the rather peculiar flight habits of the species. Mating takes place near the ground soon after adult emergence in the spring, and the flight lacks any distinct attraction to either trees or standing crops. Herbage types are thus relatively unimportant in determining the whereabouts of oviposition and subsequent white grub injury. The life cycle covers two years.

Several species of the genus *Rhopæa* are relatively common in the southern parts of the State. Outbreaks have been recently investigated at Nanango and near Killarney in pastures located on volcanic rain forest soils. The affected farms are located at the extreme ends of a basaltic outcrop which extends from the Queensland-New South Wales border to the north of Kingaroy, and it is probable that the intermediate areas are also susceptible to attack. In both outbreaks the pasture injury was similar to that already described as typical for *L. caudata* and cultivated crops—e.g., peanuts and maize—planted in newly ploughed up pastures may suffer from attacks by the carry-over larval population. The life cycle of the insects implicated in these outbreaks has not yet been elaborated but the control problem is much the same in all instances.

Studies on the Biology and Control of the Large Roundworm of Fowls, Ascaridia galli (Schrank 1788) Freeborn 1923.

[*Continued from p.* 356, *Part III., Vol. XLVI.—September,* 1936.]

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PART IV.

5. RESISTANCE OF THE CHICKEN TO INFESTATION WITH ASCARDIA GALLI.

AS evidence that chickens may display a resistance to infestation with this roundworm, the following observations are recorded:—

1. It has been noted that in naturally infested cases young birds are in general affected to a much greater extent than old birds.

2. An examination of 352 birds three years of age and over, and of 153 birds two to six months old, gave the information expressed in the following table:—

TABLE XIV.

Number of Birds Examined.	Age.	Percentage Infested.	Mean Number Worms per Bird.
352	3 years and over	27·5	6·71
153	2 to 6 months	60·8	16·93

Thus the information secured by this survey denotes that not only is the incidence of infestation much greater in young birds than in old birds, but the infestation in young birds is also heavier.

3. Under the section "Pathogenicity of Infestation," a series of experiments is outlined in which three groups of birds, namely, Group VII., Group IX., and Group XI., were fed a number of eggs per day from the ages of thirty days, fifty-eight days, and seventy-nine days respectively.

The effects of these infestations on the respective groups were interpreted by an analysis of the differences in amount of mean weekly gain between each group and its uninfested control.

Group VII.—This group was fed 100 eggs per day from the age of thirty days, the dose being increased to 300 eggs per day from the age of eighty-five days.

No curve could be fitted to the points representing the differences in amount of mean weekly gain between this group and its control, as the infested group did not at any time gain in weight to a greater extent than the controls (Graph No. 4 (B)). The plotted points indicate, however, that the infested group commenced to recover somewhere about the end of the fourth week, that is, at about this time

the group's resistance to infestation became evident. Following the increase in dosage to 300 eggs per day, it appears that this resistance was broken down, and the birds became reinfested to such an extent that the gains in weight were again affected.

Group IX.—This group was fed 300 eggs per day from the age of fifty-eight days, the dosage being increased to 1,000 eggs per day from the age of 118 days.

Graph No. 5 (B) shows that this group's resistance to infestation first became evident during the fifth week, and continued to increase to such purpose that by the ninth week the infested birds overtook the control birds in amount of weekly gain. The increase in dosage caused a marked and rapid lowering of this resistance, but the experiment was not continued long enough to ascertain whether a further resistance to this increased dosage was eventually developed.

Group XI.—This group received 500 eggs per day from the seventy-ninth day of age, and 1,000 eggs per day from the 119th day.

Graph No. 6 (B) denotes the development of a resistance as early as the third week, as a result of which the birds made such a rapid recovery that by the fifth week they were gaining in weight to a greater extent than the controls. The increase in the dosage appears to have been followed by a very rapid decrease in resistance and an equally rapid recovery.

Post mortems on these three groups at the termination of the respective trials showed in general that despite the large number of eggs fed, very few worms had survived, and that the majority of these were very small in size. In Group VII., worms reached maturity in three birds only, after forty-eight, fifty-two, and sixty-eight days respectively, which periods are very much longer than that obtained when a single dose of 100 eggs is given to birds of the same age, namely twenty-seven days. In the two other groups, an examination of the fæces showed that of the ten birds employed, worms reached maturity in only one, namely No. 63 of Group IX., eggs appearing in the fæces for the first time on the sixty-eighth day.

The three most affected birds, Nos. 68, 72, and 80, yielded very few large worms on autopsy, the infestation in each case consisting of extremely large numbers of small worms, the majority of which were under 20 millimetres in length.

From the weight curves and the autopsy findings, it is evident that a resistance to infestation was acquired by each of these groups. The period during which the birds were affected appears to have been dependent upon either the age of the group or upon the number of eggs fed. For example, in Group XI., a resistance was developed after three weeks, the birds being seventy-nine days old when first infested, and the number of eggs per day being 500, whereas in Group VII., fed only 100 eggs per day from the age of thirty days, no definite point of recovery is denoted by the graph, though it appears to have occurred some time about the fifth week. It is also to be noted that a resistance which is developed under conditions involving the administration of a number of eggs per day, may be readily broken down when the dose is increased.

A review of the observations recorded by previous investigators on the development of a resistance by the chicken to infestation with this roundworm shows that a resistance has been demonstrated under conditions involving (i.) age, (ii.) pre-infestation, (iii.) deficient diet, (iv.) loss of blood, and (v.) the breed of host.

I. AGE RESISTANCE.

(i.) Previous Investigations.

That chickens develop with increasing age a marked resistance to infestation with *Ascaridia galli* is regarded as one of the classical examples of the development of an age resistance by a host to an helminth parasite.

Herrick[64] was the first investigator to draw attention to this phenomenon, when he demonstated under controlled conditions that the growth and chance of survival of Ascaridia was inversely proportionate to the age of the host. He infested chickens varying in age from five days to 240 days, and found that, aften a ten-day infestation period, larvæ in chickens five days old showed an average gain in length of 5·3 millimetres. In chickens sixty days old the average gain in length was 2.6 millimetres; in chickens ninety days old, ·4 millimetre; and in chickens 103 days old only ·1 millimetre. In chickens older than 103 days, this gain was still ·1 millimetre, showing that birds, say 240 days old, were no more resistant to the growth of the worms than at 103 days old. The variation in the size of the worms increased from 10 per cent. in chickens five days old to a maximum of 25 per cent. at sixty days. In the older birds the growth of the worms appeared more constant, a variation of not more than 1 per cent. being noted. Moreover, the number of birds containing worms decreased from 87 per cent. among chicks five days to one month old, to 29 per cent. at twenty-one weeks and older. As the age of the birds increased, Herrick also noticed that they became more resistant to the effects of infestation.

In 1930, Ackert[7] reported an experiment in which chicks of various sizes were given a single dose of 1,000 eggs. Using birds two months old, he found that the uninfested controls made a greater gain in weight, and that on autopsy all infested chicks, except one, contained worms. With chickens ten to twelve weeks old, there was no such difference in weight, and in each age group only one bird contained worms when examined. In a further experiment, twenty-four chickens were reared under worm-free conditions till three months old, and were then placed with infested birds on contaminated soil. At the end of six weeks, all birds were thrifty in appearance, and on examination only four were infested, the maximum number of worms present in any one bird being eight. Ackert concluded from these experiments that if chickens are kept worm free for the first three months of life they may then be run on infested ground with little danger of subsequent ill effects.

Three further reports were published by Ackert et. al., in 1932 and 1935[16, 19, 20, 21], on experiments concerned with age resistance. The first detailed report appeared in 1935[21], in the compilation of which Ackert collaborated with Porter and Beach. In this experiment, chickens varied in age from thirty-seven to ninety-three days, and the results were secured after feeding single doses of 50 and 300 eggs

respectively. When the mean lengths and numbers of the worms surviving after a 21-day period of infestation in each age group were compared, it was shown that as chickens increased in age there was developed a resistance, which inhibited the growth and survival of the infestation.

In the same year, Ackert, with Eisenbrandt, et. al. [19, 20], was able to demonstrate that an age resistance was developed not only in single-comb White Leghorns, which breed had been employed in all his previous work, but also in Rhode Island Reds, Buff Orpingtons, White Plymouth Rocks, Barred Plymouth Rocks, and White Minorcas.

In an attempt to transfer this resistance by means of serum from old birds, Herrick[64] secured promising results. Using the serum from a cock 123 days old, and injecting it into a 22-day old chick, which had been infested for ten days, the autopsy findings led him to believe that such serum in this case possessed marked vermicidal properties. Serum from the same cock was also given to three other chicks in doses of 1 millilitre, 2 millilitres, and 3 millilitres, respectively. On subsequent examination, the chick into which the 3-millilitre dose had been injected was found to be free from worms, whilst each of the controls harboured over 2,000 larvæ. A third test gave evidence of a strong protective action, though the growth rate of the worms was not affected. No clear cut results, however, were secured from the use of the serum of other aged cocks, and Herrick concluded that such serum, in general, made chickens more resistant to the effects of the worms than to the worms themselves.

(ii.) Personal Observations.

In order to obtain some conceptions of the behaviour of *Ascaridia galli* in chickens of various ages, the following experiment was planned. Four groups of chickens, each of ten birds, were maintained under worm-free conditions up to the respective times of infestation. With each group three controls were allowed to run, and immediately prior to the infestation of each group were killed and examined carefully for worms. In every case the control birds were found to be worm free. Each group was given approximately 100 infectious eggs, all of which were from the one culture, and deposited by female worms secured from a single bird. The groups were infested at the ages of thirty, fifty-eight, eighty-one, and 112 days respectively. After a 21-day period of infestation the birds were autopsied, the worms present carefully collected, counted, and measured. The worms were killed by hot water, and measurements were made with the aid of a camera lucida. Two further controls accompanied the autopsy of each group, and on no occasion were these infested.

The results secured from this experiment are shown in table.

TABLE XV.

Number of Group.	Age when Infested.	Per cent Birds Positive.	Total Worms Recovered.	Mean No. Worms per Bird.	Range of Measurements of Worms.	Mean Length of Worms.
XIII. ..	30 days	100	92	9·2	18·6 mm–34·3 mm	26·72 mm
XIV. ..	58 days	100	78	7·8	12·9 mm–30·6 mm	20·84 mm
XV. ..	81 days	60	40	4·0	8·2 mm–17·8 mm	12·2 mm
XVI. ..	112 days	10	2	0·2	3·0 mm– 5·6 mm	4·33 mm

In Groups XIII., thirty days old, and XIV., fifty-eight days old, all birds were infested, but when the age of the birds was increased to eighty-one days, Group XV., and 112 days, Group XVI., the incidence of infestation decreased to 60 per cent. and 10 per cent respectively, the difference between the percentage infestation of Group XIV. and Group XV. approaching significance, and that between Group XVI. and Group XIV. being significant. The average number of worms per group, and the respective mean lengths of the worms in each group, also showed a very marked decrease as the groups became older.

When the average numbers of worms in each of these age groups were plotted against the age of the groups, a regression line was obtained, the slope of which is regarded as approaching significance (Graph No. 7 (A)). A similar method of interpretation in regard to the mean lengths of the worms in each age group also gave a straight line, the slope of which in this case is significant (Graph No. 7 (B)).

GRAPH No. 7.

AGE RESISTANCE.

(A)—Regression of Average Number of Worms in Each Age Group on Age of Group.

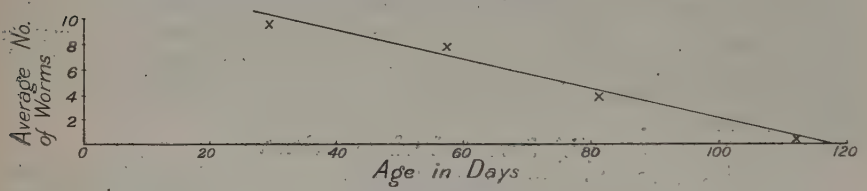


Plate 194.

$y = -1.14 (x - 30) + 9.9.$

Slope Approaching Significance.

(B)—Regression of Average Length of Worms in Each Age Group on Age of Group.

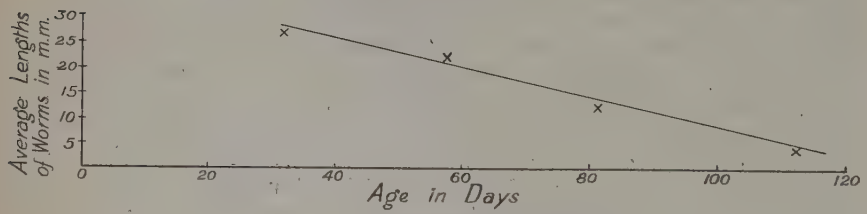


Plate 195.

$y = -0.3 (x - 30) + 28.08.$

Slope Significant.

These results are in agreement with those recorded by Ackert, and indicate that as chickens increase in age fewer birds become infested, fewer worms survive, and the growth rate of these becomes significantly retarded. Finally, at the age of about 112 days, the experiment indicates that the age resistance which is responsible for the decreasing percentage of larval survival, and the increasing influence of the growth inhibiting factor, has become developed to such an extent, that very few larvæ would succeed in establishing themselves in birds maintained under worm-free conditions till about four months old.

As an age resistance may be regarded simply as a type of natural resistance whose influence increases with age, some idea of the underlying factors may, it is considered, be obtained by examining any evidence which may indicate the existence of a natural resistance by the young bird to infestation.

Table VII., compiled in connection with larval survival in birds employed for life history studies, shows that there is a gradual decrease in the number of larvæ during the first nine days after infestation. As the larvæ occur freely in the lumen of the intestine throughout this period, their gradual elimination is most probably due to the existence of a natural resistance, the mechanism of which is not understood.

That the influences concerned with this explusion of the larvæ may become more potent with increasing age is indicated by an experiment in which five birds reared under worm-free conditions were given a single dose of 1,000 eggs when 125 days old. Autopsies of these birds, after varying periods of infestation, gave the following information:—

TABLE XVI.

Number of Bird.	Egg Fed.	Period of Infestation	Number Larvae Present.
90	1,000	6 hours	471
91	1,000	1 day	388
92	1,000	3 days	150
93	1,000	5 days	7
94	1,000	9 days	16

Owing to the small number of birds used in this experiment, the information secured cannot be regarded as conclusive evidence that in aged birds in good health large numbers of larvæ are eliminated within nine days after hatching, but it is at least indicative of the presence of a resistance which acts in this manner. Such a resistance could also be concerned in a retardation of growth, which would naturally be correlated with the struggle of the larvæ for survival.

II. ACQUIRED RESISTANCE.

(i.) Previous Investigations.

This type of resistance is developed by the host as a result of infestation, and its influence tends to become more marked under the stimulus of repeated infestations.

Herrick[64] noted that, in the case of *Ascaridia galli*, if chickens of approximately the same age were given a single feeding of eggs, there appeared to be a definite relationship between the numbers of worms harboured and their size, the greater the number of worms present, the smaller the size of the worms. Ackert, Graham, Nolf, and Porter[14] have also drawn attention to this phenomenon, and have

noted that a single feeding of twenty-five to fifty eggs was more conducive to the growth of an infestation than single doses of larger numbers of eggs. The percentage worm survival was also shown to be inversely proportionate to the number of eggs fed. These results were considered to be due to a "serological" factor operating during the period when the larvæ were attacking the intestine wall.

Graham, Ackert, and Jones[55] infested eighty-four chickens at five weeks, and again at ten weeks, and found that the lengths and numbers of the worms surviving from the second infestation were indicative of the development of a slight immunity. In a second experiment, the chickens were given carbontetrachloride to eliminate the worms resulting from the first feeding, and were then infested the second time. The evidence from this second feeding was again suggestive of a slight immunity, though in only one case were the differences in lengths and numbers of worms statistically sound. They suggest that this immunity is due to the formation of antibodies at the time when the young worms burrow into the intestinal wall.

Rebrassier and McCrory[81] endeavoured to ascertain the effect of Ascaridia extract towards establishing an immunity (passive acquired immunity). Three groups of chickens were used, and were infested when forty-six, ninety-seven, and 131 days old, respectively. Each group was then divided into three subgroups. Subgroup 1 was given infectious eggs only; subgroup 2 infectious eggs plus injections of Ascaridia extract, whilst subgroup 3 was retained as uninfested controls.

In the 46-day old group, the lot given ova plus extract made a greater gain in weight than that given ova only. Similar results were secured with the 97-day old birds, though the differences were not so marked. It was also noted that in the younger birds, the addition of the extract had some protective action against the enteritis accompanying the infestation. The extract, however, had no effect upon the number or growth of the worms.

(ii.) Personal Observations.

Referring once again to the series of experiments in which three groups of birds were fed a number of eggs per day, the autopsy findings as regards the numbers of worms surviving, and also the interpretation given to the differences in amount of mean weekly gain in weight between each of these groups and its control, indicate, it is considered, that these birds eventually acquired a resistance to infestation. The possibility that the recoveries observed may have been associated with age has not been overlooked, but it is considered, that as the resistance developed in each group appeared to be broken down by an increase in the dose of eggs, the recoveries, irrespective of the age of the group, were due mainly to the development of an acquired resistance.

It was also observed that as the groups increased in age, recovery was more rapid. Whether this was due to age, or to the fact that the older groups were given much larger daily doses of eggs than the younger group, thereby enabling the more rapid acquisition of a resistance, is not understood, though possibly both factors are implicated.

As regards the mechanism of this acquired resistance, attention is directed to the work of Bachman and Molina,[25] with *Trichinella spiralis* in pigs; and that of Roberts,[88] with *Ascaris lumbricoides* in pigs, where it has been shown that the association of an eosinophilia with an helminth infestation may be indicative of the development of a resistance by the host. Bachman's and Molina's observations in particular, are also suggestive that this resistance is concerned with the blood leucocytes and cells of the reticulo-endothelial system.

When young chickens are infested with a single dose of the eggs of *Ascaridia galli,* an examination of blood smears has shown that during the course of the infestation a marked eosinophilia may be evident. This is shown in the following table, in which the weekly eosinophile percentages of five chickens (Group III.) given a single dose of 1,000 eggs are recorded.

TABLE XVII.

No. of Chickens.	Per Cent. Eosinophiles.					
	At Infestation.	1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.
48	1·5	1·5	4·0	2·5	2·0	1·0
49	1·5	2·0	7·5	5·5	2·5	4·0
50	0	1·5	6·0	3·5	1·5	0
51	1·5	1·0	11·5	7·5	0·5	0
52	2·5	0	6·5	1·5	1·0	1·5

The eosinophile percentages from five uninfested controls during the same period varied between 0 and 2·5. In the case of each bird in the infested group, the maximum eosinophile count was recorded at the end of the second week. Prior to this the percentage was normal, and except in No. 49 returned to normal after the third week. During the fourth and fifth week, no eosinophilia was evident in any bird, except in No. 49, in which the percentage again increased to 4 at the end of the fifth week. The occurrence of an eosinophilia during the eighth to the twenty-first day after infestation is significant, as it is during this period that the larvæ attack the intestinal tissues.

An examination of Table VII. shows that after the tenth day the numbers of larvæ collected from the chickens tabulated therein decreased markedly. That this decrease is coincident with an eosinophilia suggests very strongly, it is considered, that it is due to the development of a resistance by the host, which resistance, in the light of the interpretations already made with reference to the occurrence of an eosinophilia in helminth infestations, is possibly due to a localisation of those cellular forces concerned in body defence in the tissues of the small intestine.

The degree of resistance developed would depend upon the number of larvæ present and attacking the wall of the intestine, that is, upon the numbers of eggs fed. Thus, if the experiment in which three groups of chickens, each aged thirty days and given a single dose of 100,

500, and 1,000 eggs respectively, is again considered (Groups I., II., and III.), it will be noticed, as shown in the following table, that as the dose is increased the growth of the worms is retarded and the percentage survival becomes smaller.

TABLE XVIII.

No. of Group.	No. Eggs Fed.	No. of Birds with Worms.	Total No. Worms in Group.	Per Cent. Survival of Worms.	Min. Maturity Period of Worms.
I.	100	5	112	22·4	28 days
II.	500	4	91	3·64	34 days
III.	1,000	5	119	2·38	39 days

III. DEFICIENT DIET.

The influence of nutrition on Ascaridia infestation has been the subject of a good deal of investigation by Ackert and his co-workers. In seeking for an explanation as to the reason chickens on farms appeared more susceptible to infestation than chickens on a well-regulated diet, Ackert suspected that diet may be a factor on which the susceptibility of the host depended to a large extent. Experiments were thereupon undertaken to ascertain what effect the vitamins A and B would have on this susceptibility. The first experiment to be reported in detail was conducted by Ackert, McIlvaine, and Crawford[12] in 1931, and concerned vitamin A. Four experiments were carried out using semi-synthetic diets deficient and adequate in vitamin A, and a normal full diet and also involving a variation in the age of the host and the dosage of eggs employed. The results from the first three experiments showed, as indicated by the numbers of worms surviving and their size, that the vitamin A deficient groups on the semi-synthetic diet were least resistant and the groups on the normal full diet most resistant. The results secured from the fourth experiment were somewhat confused by an increase of vitamin B and the supplementary protein allowance to the groups on the semi-synthetic diets, and although the group on the normal diet contained more worms than the group fed the vitamin A deficient diet, the worms in the normal diet group were much smaller in size. The authors concluded that the resistance of growing chickens four to seven weeks old to *A. galli* is lowered when they are maintained on a vitamin A deficient diet. They suggest that as a weakened peristalsis is one of the effects of this deficiency, such may be an explanation of the results obtained.

In 1931 Ackert and Nolf published an account of the principal results obtained in a further series of experiments concerning the effect of a vitamin B deficient diet[13]. These experiments were conducted on practically the same lines as those concerned with vitamin A. At the age of seven weeks one group of chickens was given a semi-synthetic diet deficient in vitamin B, a second group the same diet plus yeast and a third group a normal full diet. After two weeks on these diets all chickens were infested with 500 eggs of *A. galli,* and autopsied after three weeks infestation. The first group carried an average of 13.43 worms per chick, with a mean length of 13.38 mm.;

Group 2 an average of 5.28 worms, with a mean length of 18.28 mm.; and Group 3 an average of 4.41 worms, with an average length of 13·80 mm. Many of the chicks on the vitamin B deficient diet suffered from a partial paralysis of the digestive tract, and the authors consider that the larger number of worms in that group may be explained by the fact that this condition assisted the worms to remain in their natural habitat. The larger size of the worms in the chicks receiving yeast was suggested to be due to some factor present in the yeast which was favourable to the growth of the worms. Further work by Ackert and Beach[11, 15] on yeast as a factor in the growth of the worms showed, however, that in the presence of an adequate amount of vitamin B yeast does not furnish a special growth factor.

The effect of these two vitamins A and B on the resistance of chickens to infestation with *A. galli* may therefore be summarised as follows:—

The absence of vitamin A in the diet so lowers the resistance of chickens to infestation with this parasite that more worms are able to survive and also to grow more rapidly than in chickens receiving an adequate quantity of this vitamin. A deficiency of vitamin B, on the other hand, while indicating that more worms may survive appears to result in worms of smaller size than in the case of a diet adequate in vitamin B. Vitamin D, on the other hand, was considered by Ackert and Spindler to have no effect either on the growth rate or numbers of *Ascaridia galli.*

Further work by Ackert and Beach[18] on the effect of dietary supplements upon resistance to *A. galli* has shown that the type of amino-acid may influence the course of an infestation as the inclusion of skim milk and meat meal increased the growth ratio and resistance of chickens, whilst a plant diet produced slowest growth rate and least potent resistance.

IV. LOSS OF BLOOD.

Herrick[64] found that thyrectomy and alteration of the flow of bile did not in any way interfere with the development of the worms, but that the removal of large amounts of blood by cardiac puncture made the chicken less able to cope with the growth of the worms. The effect of bleeding on the growth and survival of this roundworm has also been investigated by Ackert and Porter[10]. Three hundred young chickens were used, and were divided into two groups of 150 each. Group A was bled at weekly intervals, the amount of blood taken being gradually increased from .5 ml. at four weeks old to 5 ml. at nine weeks. Group B was not bled at any time. When six weeks old each group was subdivided and each subgroup was given a single dose of eggs varying from 25 to 500 in number. Those subgroups given 300 and 500 eggs and bled contained, after a three-week infestation period, larger worms than those given a similar number of eggs and not bled. Whilst the differences between the remaining subgroups were not significant, the worms from the bled birds were larger than those secured from the birds which did not suffer any blood loss. The results were interpreted as indicating that bleeding affects the growth inhibiting mechanism, lowering the resistance of the chicken to the parasite.

V. COMPARATIVE RESISTANCE BY DIFFERENT BREEDS OF FOWLS.

In 1933 a brief note was published by Ackert, Eisenbrandt, Glading, and Wilmoth[17] concerning experiments involving the comparative resistance of six breeds of fowls to infestation with *Ascaridia galli*. These experiments were continued, and a complete report was made available in 1935[19]. A total of 1,351 chickens were used, including six breeds, namely, White Leghorns, Buff Orpingtons, White Plymouth Rocks, Barred Plymouth Rocks, Rhode Island Reds, and White Minorcas. Of this latter breed two varieties were employed. Groups of birds belonging to these various breeds were fed a single dose of 50 $\pm$ 5 embryonated eggs at the ages of twelve, twenty-one, thirty, thirty-three, and forty-four days respectively. The results as interpreted from the numbers and mean lengths of the worms present in each group after a twenty-one-day period of infestation showed that the heavier breeds, Rhode Island Reds, White Plymouth Rocks, and Barred Plymouth Rocks, were significantly more resistant than the lighter breeds, White Leghorns, Buff Orpingtons, and White Minorcas. Of the two strains of White Minorcas infested a heavy strain proved to be more resistant than a lighter strain of the same breed with a different genetic constitution. The greater susceptibility of the lighter breeds is considered to be possibly due to the fact that these breeds are markedly more active and nervous than the heavier breeds, and this greater utilisation of energy might be unfavourable to the development of inhibiting factors.

CONCLUSIONS.

From these observations the phenomenon of resistance by the fowl to infestation with *A. galli* may be summarised as follows:—

1. As birds grow old there is developed a marked resistance both to the infestation itself and its effects. This type of resistance, as recorded by Herrick and Ackert and confirmed by the writer, is denoted by the difficulty the worms experience in establishing themselves and developing in old birds. Experimental results secured by Ackert and the writer indicate that at about three to four months of age this age resistance has become developed to such a high degree that birds reared under worm-free conditions for this period could then be turned on to infested soil with slight subsequent ill effects.

In attempting an explanation of the factors underlying this age resistance, Ackert, Porter, and Beach[21] point out that their results do not confirm Sandground's view that the chicken is an abnormal host. *Ascaridia galli* was originally described from a specimen taken from a turkey, which host is inferred by Sandground to be the normal and less resistant host of this roundworm. Work by Ackert and Eisenbrandt[20], however, showed that if chickens and turkeys of the same age are fed the same dose of eggs, the chicken is less resistant to infestation, as their birds harboured more and longer worms than the turkeys. These authors are inclined to the view that the resistance is not associated with the intestinal mucosa itself, but is concerned with growth inhibiting factors in the serum of the chicken the nature of which is unknown. This hypothesis is supported by the periodic bleeding experiments of Porter and Ackert, and also to some extent by the results secured by Herrick using the serum from aged worm-free

birds. The writer's work, on the other hand, has indicated that the mechanism concerned in this age resistance may possibly be identical with that of a natural resistance which is considered to be responsible for the elimination of larvæ during the first nine days after infestation, and whose influence increases with age. There is, however, also some slight evdience that the resistance acquired as a result of infestation and developed as a result of the larvæ attacking the intestine wall,, assists the age resistance, becoming more potent with increasing age. As the factors concerned with this acquired resistance are considered to be associated with the blood serum, this evidence would favour Ackert's hypothesis of serum borne growth-inhibiting factors and age resistance, though in the light of these observations such a resistance would not be, strictly speaking, an age resistance but an acquired resistance.

2. During the period in their life cycle when the larvæ attack the intestine wall, a marked eosinophilia may be demonstrated in the peripheral blood of the host. This phenomen, together with the conspicuous diminution in the numbers of larvæ which occur at this time, is considered to indicate the development of an acquired resistance. The mechanism of this acquired resistance may possibly be associated with a concentration of the blood leucocytes and cells of the reticuloendothelial system in the tissues of the intestine wall. Under conditions of repeated infestation this resistance may be acquired to a high degree, so that, despite the continuous ingestion of large numbers of eggs over a long period, very few worms may survive to the adult stage.

3. Theoretically, therefore, old birds should remain practically unaffected by *A. galli,* both by virtue of their age and by the fact that they may have been continuously exposed to infestation over a long period. Such, however, is not the case, and serious infestations may be frequently encountered in such birds. This can be explained only by the fact that their age resistance and acquired resistance has in some way or other been broken down. Foster[50] concluded from his long experience with the resistance developed by the dog to the hookworm, *Ancylostoma caninum,* that such an immunity is conditioned upon the general wellbeing of the host, and that any factor which in any way affects this wellbeing may result in a breaking-down of the immunity. Ackert has shown that a diet deficient in vitamins A and B and in animal protein may affect the resistance of the fowl to *A. galli.* A similar lowering of resistance to this roundworm was recorded under conditions of repeated bleeding. It seems, therefore, that any other such factor which affects the health of the fowl, such as the presence of disease due to bacteria, protozoa, other helminths, or the strain upon the bird's vitality by production, &c., may also make the fowl more susceptible to infestation.

[TO BE CONTINUED.]

OPHTHALMIA OF DOMESTIC ANIMALS.

The disease known as ophthamia, which is an inflammation of the eye, and is often referred to as "blight" or "pink eye," affects all the domestic animals, although it is probably most frequently encountered in cattle and sheep.

The disease is contagious and is brought about by the entrance of a special germ into the eyes. Injury to the eyes such as is caused by grass seed is sometimes considered to be the sole cause of blight; this, however, is incorrect, for the true contagious form of the disease cannot be produced unless the specific germ is present. It must not be overlooked, however, that any foreign material which becomes lodged in the eyes will set up irritation and give rise to a non-contagious form of ophthalmia, and, secondly, eyes in such a condition are more susceptible to the contagious form.

The infective material which is responsible for setting up new cases is present in the discharges from the affected eyes, and it is frequently carried from one animal to another by means of flies. Another method of spread, particularly with sheep, is by long grass, &c., becoming contaminated with eye discharges, which are later transferred to the eyes of healthy animals grazing over the same area.

The first change noticed following infection is a watery discharge issuing from the inner corners of affected eyes. If the eyes are examined at this stage evidence of inflammation will be noticed in the form of a general reddening and enlargement of the minute blood vessels. As the disease progresses the discharge becomes more copious and full of pus, and the general appearance of the eye becomes dull. If no treatment is carried out a film appears over the eye and the animal becomes temporarily or in some cases permanently blind. The film is due to an inflammation of the surface layer of cells. Frequently the case does not extend beyond this stage, and even without treatment the eyes begin to recover gradually and return to normal. In other cases the inflammation may extend to the deeper structures, leading to permanent blindness in one or both eyes. In those cases which recover without treatment the animals may be partially or totally blind for up to a week, and during this period they are difficult to drive and usually lose condition. Losses are also experienced on account of the animals becoming separated from the rest of the herd and not being able to find water.

If animals are treated in an early stage of the disease, they soon recover. Several mixtures may be used in the form of drops into eyes, and very good results have been obtained with a 2 per cent. solution of zinc sulphate. To make this solution ½ oz. of zinc sulphate is dissolved in 1 pint of clean water, which has been boiled and allowed to cool. A 5-10 per cent. solution of argyrol is also effective. For treatment, about 10 drops of one of the above mixtures are dropped into each affected eye at least once, and, when possible, twice or more often daily. The treatment should be continued until the eyes have returned to normal.

In the case of valuable animals the discharge should be cleaned away from the eyes with a boracic acid solution, and yellow oxide of mercury ointment (1-50) should be applied to the lids to prevent them from sticking.

As the disease is contagious and rapidly spreads from animal to animal, the affected cases, particularly when only few in number, should be isolated until they have completely recovered. Particular care should be taken when new animals are introduced to see that they are not infected, as the disease is often introduced into and spread through a flock by such means.

In the case of sheep it is wise, when facilities are available, to treat all the animals and to draft off those showing evidence of the disease for more intensive treatment in a small hospital paddock.

Principles of Botany for Queensland Farmers.

C. T. WHITE, Government Botanist.

[*Continued from p.* 391, *September*, 1936.]

Part II.—ANATOMY.

THE STUDY OF THE INTERNAL STRUCTURE OF PLANTS.

CHAPTER X.

Cells.

THE previous chapters having dealt with the external features of the different plant members, root, stem, leaves, &c., attention will now be drawn to their internal structure, a knowledge of which will be found necessary before we can fully understand the work which these organs perform and the part they play in the life of the plant.

So far, for the most part, the features described can be seen with the naked eye or with the aid of a low-power hand lens, but in the study of their anatomy the use of a higher power becomes necessary. Thin slices or sections of the part to be studied are cut and examined under the microscope, and, in order that a full knowledge of their nature and relationship be gained, it is necessary that sections be made, not only in one, but in several directions. Sections are usually cut (1) at right-angles to the main axis, when they are termed transverse sections; (2) parallel to the main axis, when they are termed longitudinal sections; in the latter case the terms "radial" and "tangential" are added respectively to distinguish whether the section passes through the centre of the axis or not. (See Plate 196.)

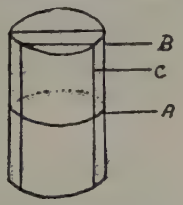


Plate 196.

Diagram to Illustrate Relative Positions for Different Sections.
A.—Transverse. B.—Longitudinal and Radial. C.—Longitudinal and tangential.

To separate the finer internal parts in the living plants is extremely difficult. On this account, the part to be sectioned is generally killed or "fixed"—i.e., it is put into a solution such as weak formalin, spirit, or other chemical solution which quickly penetrates to the finest interior parts so that they remain in the same, or practically the same, position as when alive. The sections are stained with various stains to bring out the details, and then mounted on glass slips, after which they are ready for microscopic examination. The accounts of cell division and such minute processes as are described in the following pages are not made from living cells, but from a number of such sections of an extreme thinness cut in series by mechanical aid.

The Cell.—The bodies of all living creatures, whether animals or plants, are built up of minute elementary organs called cells. In plants the individual cells are surrounded by a cell wall composed of a substance known as cellulose.

In the lowest forms of life—among animals, bacteria, and plants—the individual consists only of one minute cell and is invisible to the naked eye.

All living bodies consist primarily of protoplasm—a substance varying in consistency, but usually of a slimy, granular, or jelly-like nature; it is the basis of life, and without it the ordinary life processes of either animals or plants become impossible, death implying its destruction or decomposition.

The youngest cells are always found where growth is most actively going on—viz., at the growing points—and are called embryonic or meristematic cells, and the tissue in which they occur is known as the meristem or growing tissue. (Plate 197, A). If a thin section through a growing apex be made and examined under the microscope, the cells will be found to be more or less cubical in shape, with delicate cell-walls and filled with protoplasm. Each cell contains a central body—the nucleus (Plate 197)—clearly differentiated from the main mass of protoplasm. The general mass of protoplasm in the cell outside the nucleus is distinguished under the name of cytoplasm (Plate 197, A).

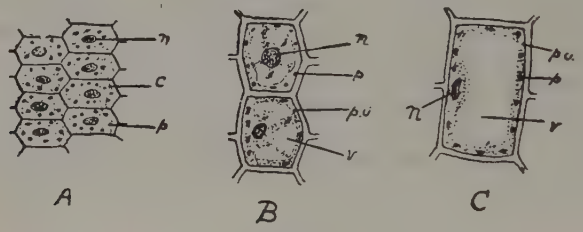


Plate 197.

Cells in Various Stages.

A.—Very young cells from near the growing point (meristematic cells).
B.—Two older cells.
C.—Single full-grown cell.
c, Cytoplasm; *n*, nucleus; *p*, plastids; *p.u.*, primordial utricle; *v*, vacuole.

In animals the older cells, like the younger, are, as a general rule, completely filled with protoplasm, but this is not the case in plants. As the plant cell increases in size the protoplasm can no longer completely fill the cell cavity, and spaces—termed vacuoles (Plate 197, B, C)—arise in the cell, the cytoplasm being reduced to a layer lining the cell wall, with perhaps a number of connecting threads across the cell cavity; this continuous layer of cytoplasm is often referred to as the primordial utricle (Plate 197, B, C). The vacuoles are filled with a fluid—termed the cell-sap—consisting mainly of water with a number of substances in solution, some intended as food for the protoplasm, others excreted from it.

Generally speaking, the cell-sap, is colourless, but often it contains a colouring matter—called anthocyanin—to which the bright colours of many flowers, fruits, and young leaves are due; also, the particular flavour of most common fruits and vegetables is due to substances dissolved in the cell-sap.

In addition to the nucleus, there occur several smaller bodies, like it, of a denser character than the surrounding cytoplasm; these are the plastids (Plate 197), three kinds being recognised:—

1. In very young cells, in underground parts, such as roots and tubers, and in deep-seated tissues the plastids are colourless, and are known as leucoplasts.

2. In parts of plants exposed to light, such as leaves, the plastids develop the green colouring matter typical of plants and known as chlorophyll; they are then referred to as chloroplasts, and practically all green parts of plants owe their colour to their presence. These minute chloroplasts are of extreme importance, as the chlorophyll they contain is essential in the manufacture of organic food substances in the living plant.

3. Chromoplasts is the name applied to plastids containing various colouring matters, generally yellowish or red; they are found in the cells of floral members of fruits, and, generally speaking, are confined to yellow and red flowers and fruits, the colours of most blue, purple, and many red flowers, &c., being due to the colouring matter anthocyanin, previously referred to.

The three kinds of plastids detailed are convertible one into another; the leucoplasts of underground parts—Potato tubers, for instance—develop chlorophyll when the particular parts are exposed to the light; similarly, chloroplasts of such plants as the Endive and Celery are artificially converted into leucoplasts by the gardener; the chloroplasts in green unripe fruits develop into chromoplasts as the fruit ripens, and those of the cells of young leaves may change into chromoplasts, producing the well-known autumn tints.

The protoplasm or living contents of the cell thus comprises: (1) the nucleus; (2) the cytoplasm; and (3) the plastids. In addition, there are a number of non-living substances found in cells; if soluble, they are dissolved in the cell sap; if insoluble, they appear in solid form. The most important of these substances are starch and proteid grains.

Starch is found as large grains most abundantly in parts which service as store places of reserve food material, as in tubers and enlarged roots, in the albumen of seeds, &c. They stain blue or violet when treated with a solution of iodine, and generaly present a characteristic stratified appearance under the microscope.

Aleurone or Proteid Grains.—These are solid grains of proteid substances found as reserve food material in different parts of the plant —mainly in seeds. They stain yellowish-brown when treated with a solution of iodine. They occur usually as minute granules, except in oily seeds, such as the Castor Oil and Candle Nut, when they are comparatively large.

Other substances are fats and oils, resins, ethereal or essential oils, caoutchouc, tannins, and mineral crystals, which will be dealt with later on when dealing with the chemical composition of plants.

Cell Formation (Plate 198).—As all plants are built of cells, a great multiplication in the number of cells must take place with the increased growth of the plant and the formation of new members. So far as we know at present, all new cells originate from pre-existing cells, and this is usually brought about by normal cell division; this only takes place in young cells, each cell as it attains full size dividing into two.

This is rather a complicated process. The whole cell about to divide enlarges; the granular substance of the nucleus changes and becomes a long thread coiled on itself, and finally breaks up into a number of V

or U-shaped pieces called chromosomes. The nuclear membrane disappears, and there arises in the surrounding protoplasm what is known as the nuclear spindle, while the chromosomes now arrange themselves round the equator of the spindle, and then gradually move apart in masses of an equal number to the opposite ends of the cell; here the chromosomes intertwine and form a spiral similar to their original form, eventually reverting to the granular condition of the original nucleus, and, like it, enclosed in a nuclear membrane. As the chromosomes move towards the two poles of the spindle, the spindle threads gradually disappear, and a thickening appears along the equator, which eventually develops into a cell wall, thus completing the division into two cells. In this way an accurate division of the nuclear contents of the cell is insured.

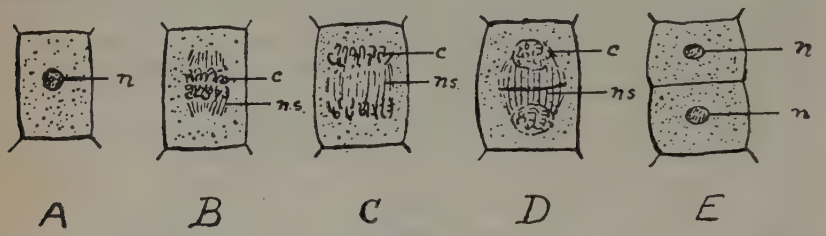


Plate 198.

Cell Division.

A, B, C, D, E.—Diagrams to illustrate various stages in ordinary cell division. *c*, Chromosomes; *n*, nucleus; *n.s.*, nuclear spindle.

This is the common type of cell division in the vegetative growing points of the higher plants; it is usually referred to as the ordinary method of cell division, and the process itself its known as mitosis or karyokinesis.

A noteworthy feature is that the number of chromosomes is constant in any given species.

It is as well to get a grasp of the general features of mitotic or karyokinetic division of the members, as the process is often referred to, not only in advanced works, but in popular ones dealing either with zoological or botanical matters, while it is the common type of cell division in animals as well as plants; in fact, in their fundamental features plants and animals approach each other very closely, even in the highest types.

Thickening of the Cell-Wall (Plate 199).—The young cell found in the meristematic or juvenile tissue are all more or less alike in size and shape; as they increase in size, however, they become variously altered in shape or structure, according to the functions they have to perform in the fully developed parts of the plant.

In the young cells the cell-wall is very thin, but as the cell attains full size the wall usually becomes thickened, the thickening substance being applied in layers on the inner surface of the original membrane; the thickened walls give firmness and strength to the structures of which they are a part.

It is rarely that the thickening takes place uniformly over the whole interior surface of the cell-wall, and parts of the original wall usually remain unthickened. Sometimes very small areas are thus left, forming narrow channels through the thickened tissues, and appearing as dots on

the surface of the cell-wall; these small unthickened areas are appropriately termed pits. What is termed a bordered pit is a modification of the simple pits, in that, as in that form, a small unthickened area arches over to form a dome instead of being closely appressed to the primary walls, as is the case with a simple pit. The apex of the dome, however, is open, and forms the entrance to the bordered pit; opposite this opening the original cell membrane is thickened, forming the so-called torus. Since the thickening substance is laid on the inner surface of the cell-wall as viewed from the outside, the bordered pits take the form of lenticular hollows, and each presents the appearance of two circles or ellipses, one within the other.

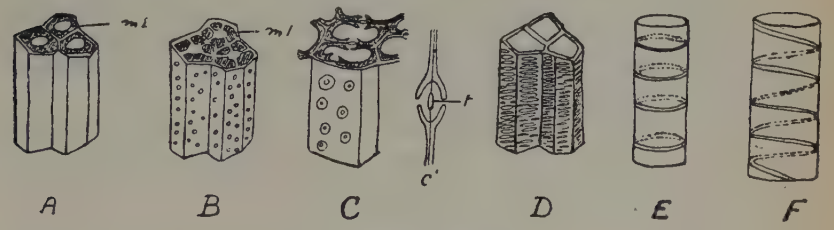


Plate 199.

Diagrams to Illustrate Thickening of Walls of Cells and Vessels.
A.—Uniformly thickened. B.—Simple pits. C.—Bordered pit. D.—Scalariform. E.—Annular. F.—Spiral.
m.l., middle lamella; *t*, torus; c^1, side view.
[A, B, and C adapted from illustrations by Percival.]

If the pits are long and narrow, appearing as transverse slits with straight bars of thickening between them, the marking is said to be scalariform. The pits of one cell-wall are placed exactly opposite the pits of the wall of an adjoining cell, serving as a means of communication from one cell to another. In the cases where more of the cell-wall remains unthickened, the thickened portions may take the form of narrow annular or spiral ring-like bands which sometimes anastomose to form a network when the thickening is spoken of as reticulate.

Alteration of the Cell-Wall.—With the growth of the cell the cell-wall not only increases in thickness, but is usually more or less changed by the addition of various chemical substances:—(1) It may by impregnation with a waxy substance called cutin become converted into cuticle—a substance very elastic, almost impermeable to water, and thus of great value to those parts of plants which require to be protected from excessive evaporation; (2) it may be converted into cork; (3) it may become impregnated with lignin—that is, lignified or converted into wood; or (4) it may be altered into mucilage, when it becomes capable of absorbing great quantities of water; mucilaginous cells are hard and horny when dry, but when moistened swell up considerably and become soft and gelatinous or sticky.

In other cases mineral matters are deposited in the substance of the cell-wall; the commonest of these is silica. Silica is present, especially in the cell-wall of the external parts of the stems and leaves of grasses, and sometimes so competely impregnates the cell-wall that when the tissue is burnt the silica remains in the form of a skeleton retaining the form of the cell.

CHAPTER XI.

Tissues and Tissue Systems.

Tissues.

The continued process of cell-division results in the formation of vast numbers of cells, and if a thin section of part of a plant be examined under the microscope it will be observed that the cells are of varying forms and sizes and that the different kinds are grouped together in various ways, according to the particular plant or part of the plant that is examined; such groups of cells associated together are spoken of as tissues.

Intercellular Spaces.—Sometimes what are known as "intercellular spaces" are formed between the cells of a tissue by the splitting of the partition walls of the cells. In plants such as the Water Hyacinth, Water Lilies, and other aquatics where lightness and buoyancy in the members are necessary, these spaces attain considerable size.

The large hollows in the internodes of the stems of bamboos, grasses, and some herbaceous plants (as in the Milk Thistle) are formed by the drying-up and rupture of masses of cells, as are the hollows of the leaves of the Onion and some other plants.

Intercellular spaces may contain various substances, such as gum, resin, or ethereal oil. The cavities usually spoken of as "oil-dots" that occur in the leaves of the Orange, Lemon, Eucalypts, and some other plants furnish a familiar example. These dots are very clearly discernible, sometimes with the naked eye and always with the aid of a lens when looked at through transmitted light. An oil gland in transverse section and much enlarged is shown in Plate 200.

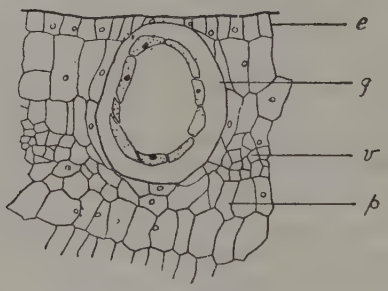


Plate 200.

Transverse Section, Highly Magnified (after Welch, in "Journal and Proceedings of the Royal Society, New South Wales"), of Portion of a Leaf of a Eucalypt, Showing Large Oil-gland.

e, epidermis; *g*, oil-gland; *p*, general ground tissue; *v*, small vascular bundle.

The so-called resin-canals, resin-passages, or resin-ducts of Conifers are really intercellular spaces into which resin is excreted by the surrounding cells.

Types of Tissue.—The tissues of plants may be classified under two headings:—

(*a*) Meristematic tissue, consisting of cells capable of growing and dividing, and thus providing new cells; it is found in those parts of plants where growth is actively taking place such as at the growing apex of stems and roots.

(*b*) Permanent tissue, consisting of cells which have reached their full development and have ceased to divide. The cells of permanent tissues vary greatly in shape, size, and other particulars, and different distinguishing terms are applied to tissues, according to the types of cells they consist of.

The cells may remain more or less rectangular or cubical in shape, forming the tissue known as parenchyma. The cell-wall may be thin, as in the soft fleshy parts of plants, when it is spoken of as thin-walled parenchyma.

In other cases the cells may become thickened, when the tissue is spoken of as thick-walled parenchyma; of this there are two principal forms: (1) Collenchyma (Plate 201–A), in which the thickening matter consists of cellulose laid down at the corners of the cells, and which is found just below the surface in many young stems, petioles, and midribs of leaves, &c., giving them the necessary firmness; (2) wood parenchyma, in which the cell-walls are lignified; this is referred to as soft tissue in descriptions of timbers.

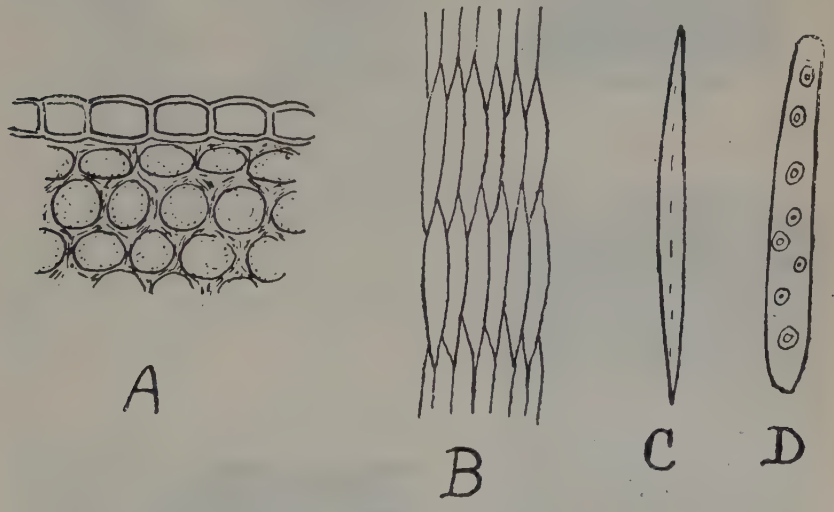


Plate 201.

A.—Collenchyma. B.—Prosenchyma. C.—Woody fibre. D.—Tracheid.

The cells may become long and pointed at both ends, the ends dovetailing in between those of other cells without intercellular spaces, and forming the tissue known as prosenchyma (Plate 201–B). Prosenchymatous cells, which early lose their protoplasmic contents, and in which the cell-walls are more or less thickened, are called fibres (Plate 201–C). When the walls become lignified they are termed wood fibres.

Tissues in which the walls of the cells are very much thickened and hard are distinguished under the name of sclerenchyma; the small gritty masses that occur in the fruit of the pear provide a familiar example. In the section of a tree-fern stem, the bands of hard strengthening tissue shown in Plate 88 are formed of sclerenchyma.

Tracheids (Plate 201–D) is the name applied to cells of a somewhat elongated shape and with thickened, usually lignified walls; they are similar to fibres, but the ends are blunt. By the absorption of the

transverse partitions (coincident with the disappearance of the protoplasmic contents) longitudinal rows of such cells may become converted into what are termed vessels.

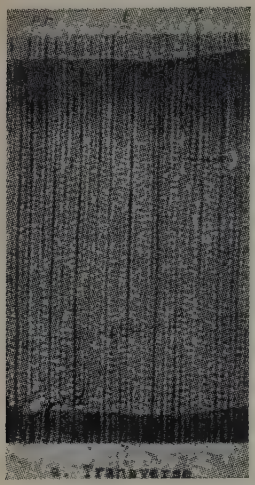


Fig. 1.

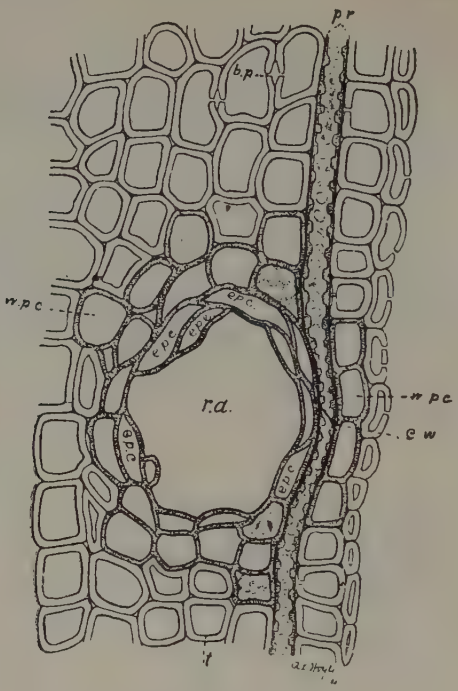


Fig. 2.

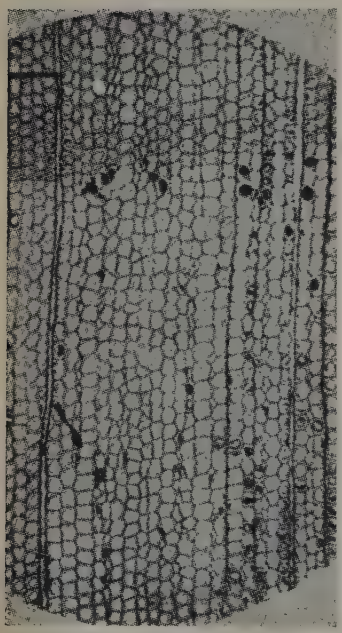


Fig. 3.

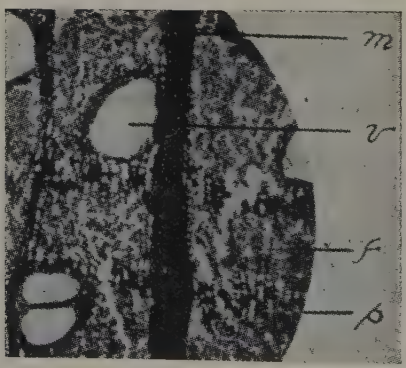


Fig. 4.

Plate 202.

In the Angiosperms (Plate 202, Fig. 4) the vessels are characteristic structures of the wood; they may attain a considerable size, and on transverse section often show up plainly under a low-power lens as pores. In Gymnosperms (Pines, &c.) tracheids only occur (Plate 202, Fig. 3).

The essential difference between a tracheid and a vessel lies in the fact that the former is developed from a single cell, whereas the latter is a long, tubular structure derived by cell fusion from a longitudinal

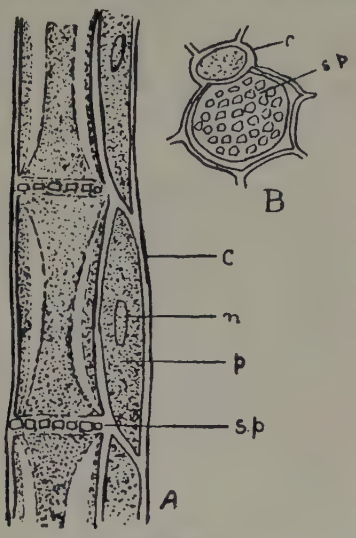


Plate 203.
Sieve Tubes and Companion Cells.

A.—Longitudinal section. B.—Transverse section. C.—Companion cell. *n*, nucleus of companion cell; *p*, protoplasm (cytoplasm); *s.p.*, sieve plate.

row of cells. The tracheid, as it were, corresponds to a single joint of a vessel. Tracheal tissue is particularly important as a conductor of watery solutions from the root to the foliage leaves and other parts of the plant.

DESCRIPTION OF PLATE 202.

Vessels, Tracheids, and Resin Ducts as seen in Transverse Sections of Timbers.

1. Transverse section through the wood of an American Pine (*Pinus ponderosa*); the section is cut through a single annual ring; the wood, with the exception of the pith rays (*p.r.*) is composed almost entirely of tracheids (*t*). The late wood of the ring is easily distinguished from the early wood by its dense character and much thicker walls of the tracheids; the late wood of one and the early wood of another ring can be clearly seen in the lower and upper edges of the section respectively. Two resin ducts can be seen, one towards the left-hand bottom corner, and the other towards the right-hand top corner of the section. The section is magnified 20 diameters.
2. Transverse section of a resin duct of *Pinus ponderosa* with its surrounding tissue, magnified 250 diameters; *b.p.*, bordered pits; *e.p.*, epithelial cells; *p.r.*, pith ray; *r.d.*, resin duct; *t*, tracheids; *w.p.c*, wood parenchyma cells.
3. Transverse section through an Australian Pine (*Araucaria Cunninghamii*). The wood of the Australian conifers does not possess any resin ducts and is composed almost entirely of tracheids. Two medullary rays are shown in the picture; their cells are mostly empty. The black particles represent deposits of manganese compound. The areas of early and late wood are not particularly well defined. Section magnified about 80 diameters.
4. Wood of a Dicotyledonous or Broad-leaved tree (*Tarrietia argyrodendron*), Booyong or Crows-foot Elm. The wood is composed of vessels, fibres, and wood parenchyma; the vessels or pores (*v*) are large and often septate; the wood-parenchyma or soft tissue (*p*) alternate with bands of fibres (*f*); the medullary rays (*m*) has its cells filled with a brown deposit. The section is magnified about 45 diameters.

[Figs. 1 and 2.—Taken from illustrations by Sudworth and Mell in "Forest Service Bulletins" 101, U.S. Dept. Agriculture; Fig. 3, from Baker and Smith's "Pines of Australia"; and Fig. 4, R. T. Baker's "Hardwoods of Australia."]

What are termed sieve tubes (Plate 203) are, like vessels, formed from longitudinal rows of cells. The walls are thin, and there is a lining of cytoplasm, but no nucleus. The transverse partitions, instead of being completely absorbed, are modified to form sieve plates, and are perforated by a number of small pores through which the contents of the cells can pass. Sieve tubes are conductors of organic food substances from the leaves to the places where they are required. A peculiar fact about them is that they are in close contact with elongated thin-walled cells, which, from their association with the sieve tubes, are called companion cells.

Many plants, when cut or wounded, freely exude a milky fluid termed latex; it is contained in the so-called lactiferous tubes or vessels. Sometimes lactiferous tubes arise from the continued development of a single cell; sometimes by the fusion of several cells, as in ordinary vessels. Lactiferous tubes are usually branched; their walls consist of cellulose, are usually somewhat thickened, and have a thin lining of protoplasm with nuclei.

Latex is present in many plants scattered through several families, and is particularly well developed in the *Asclepiadaceæ* (Hoya, Wild Cotton, &c.), *Apocynaceæ* (Tonic Bark, Milk Wood, &c.), *Caricaceæ* (Papaw, &c.), *Euphorbiaceæ* (Spurges), and *Moraceæ* (Figs, &c.). Sometimes, as in the India-rubber Fig, Para Rubber, Opium Poppy, &c., it is of considerable economic value; it may be acrid and poisonous, as in the Milky Mangrove and Mistletoe Tree (*Euphorbia Tirucalli*).

Tissue Systems.

The different forms of tissue described are grouped together in various ways in the plant members to form tissue systems. On broad lines three main systems are recognised—(1) epidermal system; (2) vascular system; (3) fundamental or ground tissue system.

1. *Epidermal Tissue.*—This comprises the epidermis or the entire outer skin of the plant. The epidermis may consist of a single continuous layer of cells, or may be several cells in thickness. In stems and leaves the external walls of the cells are more or less thickened and hardened, and form a thin closely applied skin known as the cuticle; it is particularly well developed in leathery leaves, and very strongly in succulent plants adapted for desert conditions, as the Prickly-pears, &c., in which it can more or less easily be detached as a thin, tough, more or less transparent skin from the other layers.

The epidermis is also often provided with an additional covering in the shape of deposits of wax or various kinds of hairs.

2. *Vascular Tissue System.*—A typical vascular system is only developed in the higher *Cryptogams* (Ferns and their allies) and the *Phanerogams* (flowering plants), and together these two groups constitute the vascular plants. The vascular bundles or strands consist of strong, tough tissue running longitudinally through stem and root and passing out into the leaves in string-like cords.

It is continuous through all parts of the plant, giving strength and flexibility to the members, and serving for the conduction of nutritive substances. The intricate vascular systems of the leaves can easily be seen in "skeleton" leaves which are either produced artificially by macerating the leaf in water and carefully washing away the softer tissues, or simply by natural decay.

A vascular bundle (Plate 204), as in stems and leaves, may consist of two distinct parts—the xylem or wood and the phloem or bast—or, as in roots, may consist of wood or bast only. The wood consists chiefly of vessels and tracheids, or, as in conifers, of tracheids alone; associated with the tracheal tissue are some parenchymatous cells—the wood parenchyma or soft tissue, and some long, narrow cells with thickened walls—the wood fibres. The bast consists of sieve tubes with parenchyma and fibres.

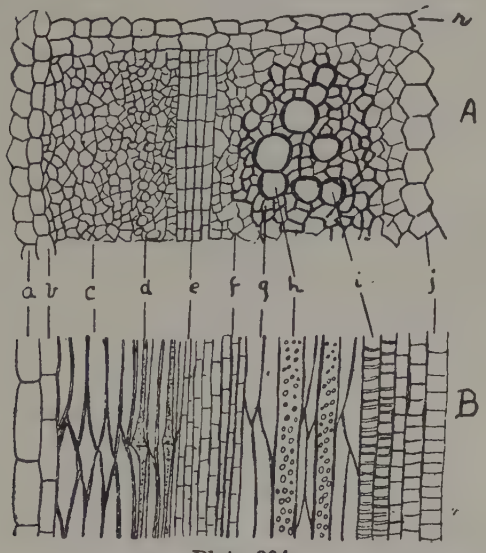


Plate 204.

A.—Transverse and B Longitudinal (Radial) Section through a Typical Vascular Bundle (Diagrammatic).

a, cortex; *b*, endodermis; *c*, pericycle fibres (hard bast); *d*, sieve-tube tissue (soft bast); *e*, cambium; *f*, wood parenchyma; *g*, wood fibres; *h*, pitted vessels; *i*, annular vessels; *j*, pith; *r*, medullary ray; *c-d*, constitute the phlœm or bast, and *f-j*, the wood or xylem.

Origin and Development of the Vascular Bundles.—The vascular bundles and the various other forms of permanent tissue described do not, of course, suddenly arise in their perfected state, but are formed by the gradual alteration of some of the cells of the young tissue. At some little distance behind the growing point certain groups of cells become elongated, forming strands known as the procambial strands; these are really the young or rudimentary bundles which, further back in the older plants, can be seen in their fully developed form.

3. *Fundamental or Ground Tissue System.*—All tissue which does not belong either to the tegumentary or to the vascular system is classed as the fundamental or ground tissue, and under such a broad heading it is natural that a great variety of cell forms will be found. It comprises the succulent parts of leaves, fruits, young stems, &c., and consists mainly of thin-walled, usually large-celled parenchyma, but may contain also sclerenchyma, collenchyma, lactiferous, and glandular tissue, &c. Intercellular spaces are frequent. Sometimes it is marked off into distinct regions such as the pith and medullary rays of stems, the palisade tissue of leaves, &c., as will be found detailed in the following chapter when dealing with the structure of the different members.

CHAPTER XII.

Anatomy and Development of Plant Members.

A Stem.

A.—(1) Stems of Dicotyledons and Gymnosperms.

Primary Structure.—If a thin transvere section be made of the stem of some herbaceous plant, or of a young stem or branchlet of a tree, and examined under a powerful hand lens or microscope, the vascular bundles will be found arranged in a circle round the stem (Plate 205).

The general ground tissue may be divided into three definite regions —that lying within the ring of bundles forming the pith, that lying outside the bundles—i.e., between the bundles and the epidermis—forming the cortex, and that lying between the bundles and called the primary medullary rays. The vascular bundle system, the medullary rays, and the pith form a central cylindrical mass of tissue known as the stele or vascular cylinder; it extends throughout the whole plant from root tips to the young parts of the stems and branchlets.

The innermost layer of cells belonging to the cortex and forming a continuous sheath round the stele is termed the endodermis. The outermost portion of the stele which lies in contact with the endodermis is termed the pericycle. The endodermis and pericycle are much more distinctly marked off in roots than in stems. The pericycle is important, as from it originates all secondary and adventitious roots. It may consist of only a single layer of cells, but in stems generally consists of several layers, and may be composed simply of parenchymatous tissue or parenchymatous tissue with masses of fibres known as the pericycle fibres or hard bast (Plate 204); these may have tough and flexible walls, to which fact is due the use of the bast fibre of many species in the manufacture of ropes and cordage. Bast fibres are well developed in the three closely allied families *Malvaceæ* (Mallows), *Sterculiaceæ,* and *Tiliaceæ,* and in the *Linaceæ* (Flax), *Urticaceæ* (Figs, &c.), *Thymelaeaceæ* (Tie Bushes), and other plants.

Longitudinal Course of the Bundles.—The bundles run parallel to the stem and are continued into the leaves. If a bundle be traced upwards, it is found to pass through one or more internodes, and then to bend outwards and pass into a leaf; at the point where this bending takes place another bundles arises, and it likewise continues through one or more internodes and passes out into a leaf, and so on through the whole length of the stem. The course of a bundle can, perhaps, be more clearly followed downwards—e.g., tracing it out through a leaf it is found to pass down into the stem through one or more internodes, and then to divide into two branches, each of which coalesces with other bundles entering the stem from older leaves further down.

Secondary Growth (Plate 206).—In trees and shrubs a further process sets in, termed secondary growth in thickness. The steady increase in thickness from year to year of the stems and branches is due to the activity of the cambium of the bundles, and when secondary growth is about to begin certain cells in the medullary rays also become meristematic; these lie between the cambium of the bundles and cross from one to the other so that a complete cambium ring is formed in the stem.

From the cambium ring new cells are continually being formed, both on the inside and outside of the ring, those formed on the outside being

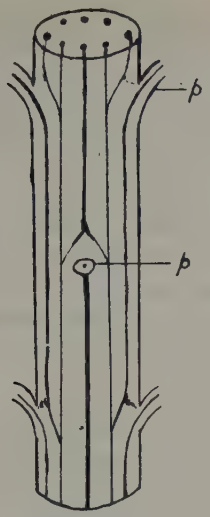


Plate 205.

Diagram to Illustrate Longitudinal Course of Bundles in a Dicotyledon. *p*, base of petiole.

developed into additional bast or phloem elements, and those on the inside into xylem or wood elements, the amount of wood produced being considerably greater than the bast.

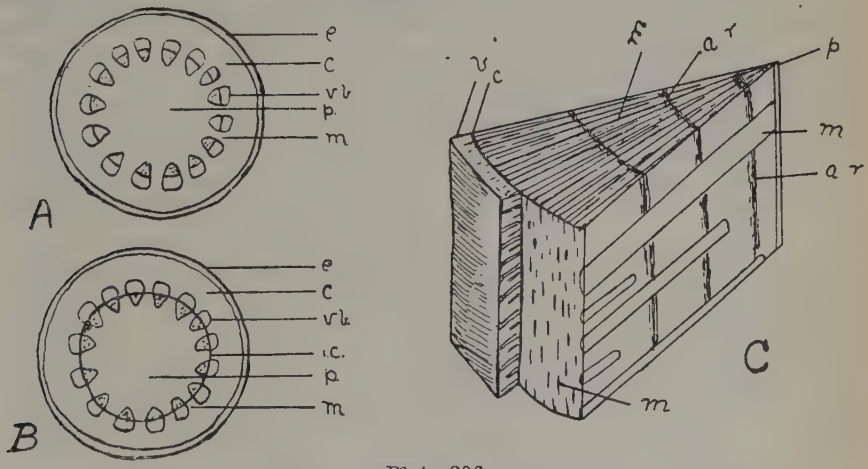


Plate 206.

Diagrams to Illustrate Secondary Thickening of Stems.

A.—Transverse section of a young stem before formation of the interfascicular cambium.

B.—Transverse section of a young stem after formation of the interfascicular cambium.

c. cortex; *e*, epidermis; *i.c.*, interfascicular cambium; *m*, primary medullary ray; *p*, pith; *v.b.*, vascular bundle, consisting of an outer portion, the phloem or bast, a central narrow band of tissue, the cambium, and an inner portion, the xylem or wood.

C.—Portion of a four-year-old stem.

a.r., annual ring; *b*, bark, consisting of the cortical and bast tissues; *c*, cambium; *m*, medullary ray; *p*, pith.

The cambium forms a continuous ring of thin-walled, actively dividing tissue between the wood and bast, and as it consists of living, very thin-walled cells, it is easily ruptured when the bark is stripped from the tree. When the tree is in full growth the bark is more readily detachable than during a more or less dormant period, such as during cold or dry weather. This is due to the fact that during the actively growing season there is always a layer, several cells in width, of still undifferentiated cambium. These cambium cells are rich in protoplasm, and when ruptured act as a sort of lubricant, by means of which the bark is easily stripped off in long unbroken lengths.

The cambium produces considerably more wood than bast; moreover, as the bast consists largely of thin-walled tissue, it soon becomes crushed into very thin sheets betwen the outer dead resistant bark and expending wood, which, with its large thick-walled vessels and lignified tissue, suffers little in this way.

Secondary Medullary Rays.—The cambium between the bundles, as well as the bundle cambium, produces wood and bast elements on the inner and outer sides respectively, and, seeing that this is the case, the primary medullary rays are thus broken up; certain cells, however, instead of producing xylem and phloem, produce totally new, very narrow medullary rays consisting of parenchymatous cells extending radially through both the secondary wood and bast elements. As the stem increases in thickness new medullary rays arise between those already formed.

The secondary rays first formed extend from the pith to the cortex, those formed later being of variable length, being successively shorter the later they are formed. The comparative width and distance apart of the medullary rays are important points in the description and identification of timbers. They are sometimes exceedingly narrow, being only one cell thick and scarcely visible to the naked eye, while at other times they are comparatively broad, being several cells thick, and appear as radial lines of lighter tissue plainly visible to the naked eye; they are exceptionaly broad in most of the Silky Oaks and She-oaks, giving to those timbers their distinctive beauty. Medullary rays also vary considerably in depth, as can be seen in radial longitudinal section, and must not be thought to run continuously from base to apex of the stem. They are very important, as by them communication is ensured between all the living cells of the stem. They serve not only to supply the phloem and other tissues with water absorbed from the wood, but by them the latter also receives various food substances manufactured in the leaves and conveyed down the stem by the sieve tubes. In the cells of the medullary rays also are stored various food substances for use by the plant in the actively growing season.

Annual Rings.—In plants with definite resting and actively growing periods, such as deciduous trees, the wood in cross-section is seen to exhibit a number of more or less easily discernible concentric rings. This is due to the wood formed by the cambium at the beginning of the growing season—usually the spring—being of a softer nature and provided with larger and more numerous vessels than the wood formed at the end of the season—usually the autumn—which is of a denser nature. As naturally follows, the next spring-wood is formed just outside the last layer of autumn-wood, so that the contrast between the two is very marked, producing the so-called annual rings. In the wood of many trees of tropical and sub-tropical countries marked annual rings

are absent, except in the case of deciduous or semi-deciduous species, such as the Red Cedar (*Cedrela*), White Cedar (*Melia*), &c.

In Queensland native trees, both Eucalypts and rain-forest species, annual rings which are fairly distinct may be formed. Experience has shown, however, that they cannot be absolutely relied on to give the age of the tree, though they are approximately correct. Probably in all seasons an annual ring is formed, but in some cases the rings are indistinct and more than one seems to be formed in a season. Climatic changes, particularly periods of rain alternating with long seasons of drought, would be responsible for this.

Heart-wood.—The marked distinction in colour that is sometimes seen between the sap-wood and the heart-wood has already been referred to. The heart-wood generally consists of dead tissues and acts as a fairly strong support for the tree; the cells of the wood parenchyma have lost their living contents, and the vessels no longer act for the conduction of water, and become impregnated with tannin and other substances, to which the dark colour and also largely the durability of the heart-wood are due. In some soft woods there is no marked distinction in appearance between sap-wood and heart-wood, and the latter may contain living tissue.

In many old trees the heart-wood rots away, leaving the lower part of the trunk and sometimes the main branches hollow; but, as, however, the heart-wood consisted only of dead tissue, this does not directly cause the death of the tree, the newer wood and the bast elements acting as conductors of water and food materials. This "pipiness" in the trunk is very marked in Australian hardwood trees, particularly Eucalypts.

Formation of the Bark.—In herbaceous plants the epidermis continues to increase so as to accommodate itself to the increasing development of wood and bast elements within; but in woody plants, as a rule, the epidermis becomes ruptured and falls off after the first year of development, in older plants an epidermis only being found on the young shoots and the leaves.

New protective tissues, however, arise, due to the formation of a secondary meristematic tissue known as the cork-cambium. This is commonly produced just below the epidermis; it may, however, arise in the cortical tissues, as in the Eucalypts, or even in the pericycle, as in some Tea Trees. It divides in the same way as does the ordinary cambium, but, unlike that, does not give rise to wood and bast; instead, the cells produced by it on the outside eventually lose their protoplasmic contents and become converted into cork, while those formed on the inside retain their protoplasm and often contain chlorophyll, and constitute the tissue known as phelloderm. Quite commonly cork cells are alone formed. The cork effectively takes the place of the epidermis as a protecting tissue to the interior parts of the stem, shielding them from mechanical injuries; being almost impermeable to air and water, it further acts as a preventive of excessive exaporation, and, as it is a bad conductor of heat, it protects the delicate inner tissues underlying it from excessive degrees of temperature, whether of heat or cold. When the cork-cambium, instead of being produced just below the epidermis, originates deeper the living cells outside are prevented by the impermeable cork produced from obtaining their necessary supplies of food and water, and in consequence

dry up and die, forming a rough outer layer of dead bark, part of all of which sooner or later is shed in various ways or becomes very much cracked and fissured.

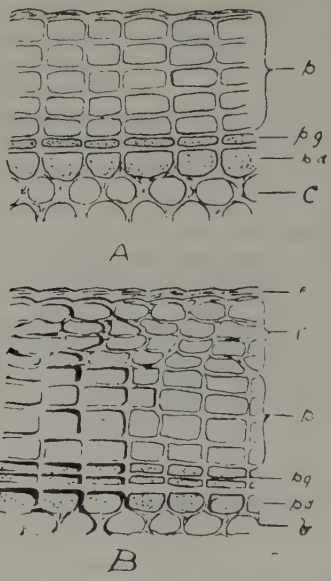


Plate 207.

Diagrams to Illustrate Cork Formation.

A.—Phellogen arising just below the epidermis; and B deeper in the cortical tissues. C.—Cortex (withered in the case of B).

b, bast tissues; *e*. epidermis; *p*. phellem or cork; *pd*, phelloderm; *pg*, phellogen.

In some cases the first-formed cork-cambium persists throughout the life of the tree, new cork cells being formed below as the older ones fall off or die. In most cases, however, the first cork-cambium ceases to be active, and a secondary one is formed deeper in the tissues; this again in its turn ceases to give rise to new cells, and a further one is formed still deeper in the tissues, and so on in this way until a number of successive periderms may be formed. As the successive cambiums are formed deeper and deeper in the cortical tissues, they eventually come to lie very close to the vascular bundles, and in some cases may even arise in the bast itself.

In this again, as where the primary cork-cambium arises in the deeper tissues, the outer living cells are cut off in the same way from supplies of food water, and in consequence die and are added to the outer layers of dead bark.

In trees such as the Plane Trees, Bolly Gum, Crow's Ash, Kauri Pines, &c., where the outer bark is shed in scales, the cork-tissue bordering on the scale consists of thin-walled, brittle cells, which are easily crushed or broken between the expanding trunk and non-growing scale, with the consequence that the scale is shed.

In some cases the bark is shed in tough, thin sheets somewhat the thickness of ordinary paper; this is due to the fact that the thin sheets of bark consist of hardened tissue lying between a few-layered stratum of thin-walled cells, which are easily torn through, the bark then peeling off in papery layers. Sometimes, as in the Paper-barked Tea Trees, the

numerous thin layers are held together and hindered from falling off by numerous strands of bast-fibres which belong to the withered cortical system cut off by the deeply-seated phellogen or cork-cambium.

When the original phellogen persists throughout the life of the tree, or when a phellogen remains active for a number of years, it may produce very thick layers of cork, which reach their maximum in such trees as the Cork Oak (*Quercus Suber*), the various trees known in Australia as Corkwoods (e.g., species of *Erythrina*, *Duboisia*, *Alstonia*, &c.). Sometimes the cork is produced in the form of narrow wings, as in the Cork Vine (*Mezoneurum brachycarpum*).

Young trees often have a smooth bark, while older trees of the same species possess rough, fissured, or scaly barks. This is due to the fact that in the young tree the bark is alive and the cells composing it divide and keep pace with the increasing trunk. As the tree gets older the bark is unable to do this, with the result that, unless the outer dead layers are thrown off, it becomes more or less deeply cracked and fissured.

Some trees periodically cast off the older layers of bark and present a new coat of smooth, clean, often glossy bark. Among Australian trees the various smooth-barked gums or eucalypts are familiar examples—e.g., Blue Gum, Grey Gum, Scribbly Gum, &c. Some others have two distinct bark systems, the bark on the basal parts or lower half of the tree remaining persistent, that on the upper part of the barrel and branches being periodically shed in various ways, as in the Moreton Bay Ash, Gum-topped Box, Flooded Gum, Blackbutt, &c. This form of bark system is probably a result of adaptation to local conditions, the lower rough, persistent bark being a bad conductor of heat, acting as a protecting cover to the delicate inner tissues of the tree when the ground in which they live is more or less regularly swept by bush fires.

Lenticels.—Scattered over the branchlets, and even the stems in some cases, may often be seen pale-coloured spots, usually of an oval shape and well differentiated from the rest of the bark; these are termed lenticels, and are much more abundantly produced in some species than in others, their relative abundance being usually referred to in descriptions. They may be seen well developed in the Red Cedar, the White Cedar, &c. Sometimes in branches with a whitish or pale-coloured bark they may be differentiated as darker spots than the surrounding bark, as may be seen on young shoots of Cudgerie (*Flindersia Schottiana*), Tulip-wood (*Harpullia pendula*), &c. At these points the cork-cambium, instead of producing cells packed closely together in the usual manner produces cells arranged in loose, granular, powdery masses. These allow the necessary interchanges of gases between the outer air and the intercellular spaces in the interior of the stem and branches.

Healing of Wounds.—Injuries made into the soft parts of plants such as herbaceous stems, leaves, and fruits, usually become covered over by a greyish-brown corky tissue developed by the outermost layer of cells which remains uninjured.

In woody stems which have been injured, cork is not immediately formed, but the cambium and the very young cells of the wood and bast bordering on the wound become active and give rise to a cushion of thin-walled cells termed a callus. In the outer layers of the cells of the callus a cork-cambium or phellogen is developed, while the layers of cells continuous with the old cambium like it give rise to wood on the inside and bast on the outside. The tissue thus formed is usually spoken of as

wound-tissue, and, owing to the abnormal conditions under which it is formed, it often differs considerably from the normal tissues. This wound-tissue continues to grow rapidly until the wound may be eventually completely covered over. The wounded area now becomes covered over by new layers of growth in the ordinary way until no external sign of its existence is visible.

The wood cells exposed by the wound die and turn a dark colour, and no close union or growing together is possible between them and the new wood formed by the cambium of the callus, so that a distinct line of demarcation between the tissues always exists. Thus it is that old marks made on growing trees, such as surveyor's marks, &c., can be traced quite plainly in the wood, though they may have been covered over by many annual layers of new wood and no external sign of their presence is visible.

When branches are cut off above one or more living buds, the buds, by sending out leafy shoots, may keep the branch alive until a callus has been formed and the deal cells at the end covered over by a wound-tissue.

If, on the other hand, the cut stump carries no buds, the tissues shrivel up and die, and a ring of callus is formed at the base of the stump, but as the new tissue formed by it has to push its way up under the old dead cortical tissues adhering to the stump, healing is slow and decay may set in before the wound becomes covered; hence the necessity, in pruning and cutting off branchs, to cut them as close to the parent stem as possible, so that the callus tissue may meet with no obstacle in growing over the wounded area. Clean-cut wounds heal much more quickly than rough, jagged ones, and it is hence advisable, when large branches are cut off with a saw, to trim the exposed cambium edges with a sharp knife or chisel. It is also a good plan to assist nature in preventing the decay of the dead wood by painting the exposed surface over with Stockholm tar or other antiseptic dressing.

A.—(2) Stems of Monocotyledons.

General Structure.—In a transverse section of a typical monocotyledonous stem, such as that of a palm, the vascular bundles, instead of being arranged in a ring, are found to be irregularly scattered through the general ground tissue. (Plate 208.) Usually the cortex is very narrow, a marked pith is rarely present, and, owing to the scattered nature of the bundles, medullary rays are absent. There is a gradual transition, however, from the dicotyledonous to the monocotyledonous type, and in some cases, as in many grasses or sedges where there is a large central hollow or pith, the bundles may be confined to a narrow outer ring of ground tissue, and in some cases may even be arranged in a single ring round a central pith.

The wood usually lies in the form of a V, the annular and spiral vessels lying at the apex of the V, and one or more larger pitted vessels lying on either arm, the whole accompanied by more or less wood parenchyma. The phloem tissue consists of sieve tubes and companion cells, and lies more or less between but a little above the large pitted vessels.

As previously stated, the bundles are closed—i.e., they contain no meristematic tissue or cambium, and hence secondary growth in thickness does not occur, no further change taking place after the complete development of the primary vascular cylinder. On this account the stem may

be not only of much the same thickness throughout, but the upper part may be larger than the lower, as may be seen in many large grasses, such as Maize, Sugar-cane, &c. This is due to the fact that such stems soon reach their maximum development in thickness at the base, and the portions formed later may receive more food and attain a greater thickness. This style of growth produces a rather unstable structure, but one firmly anchored in the soil by oblique roots, which often, as in the Maize, Screw Pine (*Pandanus*), &c., take the form of props or stilts. In many large Palms the base of the stem is often more or less expanded; this is due to distention of the ground tissue.

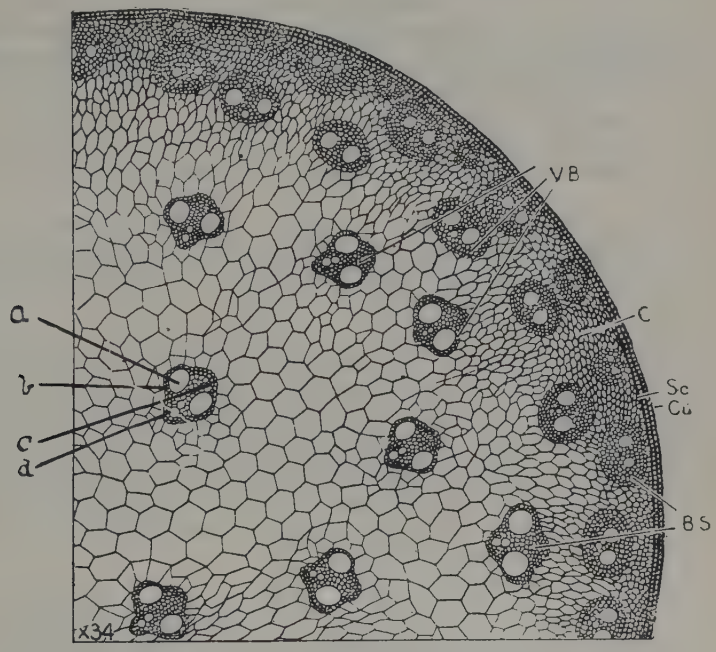


Plate 208.

Transverse section through stem of Johnson Grass (*Sorghum halepense*). Much enlarged.

B.S., bundle sheath; *C.*, ground parenchyma; *Cu.*, cuticle; *Sc.*, strengthening zone of sclerenchyma; *V.B.*, vascular bundle.

Lettering on left for the parts of a single vascular bundle: *a*, pitted vessel of xylem; *b*, sheath of sclerenchymatous fibres (bundle sheath); *c*, phloem; *d*, spiral and annular vessels (protoxylem); lying between the bundles is a certain amount of xylem parenchyma.

[After Breakwell in "Agricultural Gazette of New South Wales."]

Special Strengthening Tissue.—Though no true bark is formed by most Monocotyledons, just below the epidermis the ground tissue is strengthened; the individual bundles are also usually surrounded by a sheath of hard tissue or sclerenchyma which considerably strengthens the stem. When especially well developed, as in Palms, these hardened masses show up on transverse section as a number of small, hard, black areas, and give to their wood the distinctive strength and beauty that make them in demand for walking-sticks, &c. To the same tissue is also due the strength of such well-known fibres as Sisal Hemp, New Zealand Flax, and Manila Hemp—all obtained from monocotyledonous plants.

Longitudinal Course of the Bundles.—In the Monocotyledons the bundles do not run parallel to the surface of the stem. From the base of the leaves a number of bundles can usually be traced into the stem, first passing obliquely towards the centre, and then curving outwards again towards the surface, passing through one or more internodes and eventually coalescing with older bundles in the lower part of the stem. As the numerous vascular bundles or leaf traces penetrate the stem to varying depths, transverse sections show the scattered arrangement characteristic of the Monocotyledons.

B.—Roots.

General Structure.—The arrangement of the vascular tissue in roots is very different from that which prevails in stems. The xylem and bast strands of each bundle separate as they enter the root. A transverse section of a young root shows a number of bundles, but instead of each consisting of wood and bast elements, as in those of the stem, each consists of xylem or bast only, the xylem bundles alternating with the bast bundles.

A further differentiation lies in the fact that development of the primary wood proceeds inwards, not outwards as in the stems. This is due to the vascular strands becoming twisted upon themselves as they pass from the stems into the roots.

Secondary Growth in Thickness.—In roots secondary growth in thickness proceeds at the same time as similar growth in the stem. When secondary growth is about to begin, cambium plates appear to be brought about by certain cells of the general ground tissue opposite to each bast strand becoming meristematic, and thence, owing to more cells becoming active, the cambium plates extend laterally on either side till they meet opposite the xylem bundles and thus form a continuous cambium ring. This ring—as in the stem—gives rise to xylem elements on the inner and bast on the outer side respectively.

Certain cells of the cambium ring—those opposite the xylem strands—instead of giving rise to secondary wood and bast, usually produce broad medullary rays of parenchymatous tissue. Smaller secondary rays are also formed. The wood in old roots is, as a rule, more porous than that formed in stems, but otherwise root-wood and stem-wood resemble each other very closely.

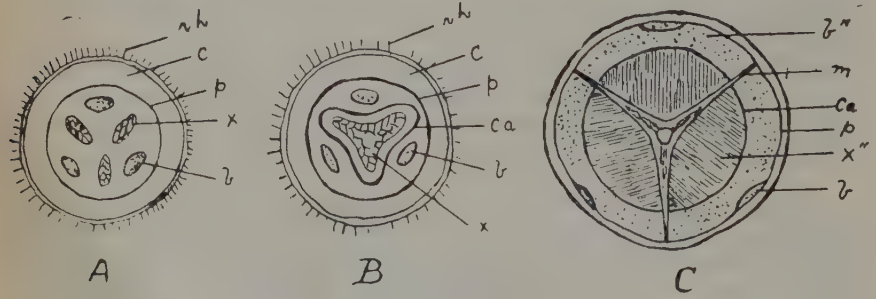


Plate 209.

Diagram to Illustrate Secondary Thickening in Roots.

A.—Transverse section of a very young root.

B.—The same when cambium has formed a continuous band.

C.—After secondary thickening has been in progress some time.

b, primary bast; b^{11}, secondary bast; *c*, primary cortex; *ca*, cambium; *m*, primary medullary ray; *p*, pericycle; *r.h*, root-hairs; *x*, primary xylem; x^{11}, secondary xylem.

Growing Point.—In the stem the tender growing point is protected by rudimentary leaves; roots, of course, produce no leaves, but the growing point as it pushes downwards through the earth is protected by a mass of tissue known as the root-cap.

The outermost cells of the root-cap are continuously dying away, but as quickly as they do so other cells are added by actively dividing meristematic tissue in the lower part of the cap. A little distance behind the growing point are found the root-hairs; as previously explained, these are elongations of some of the epidermal cells, and they adhere very closely to the particles of the soil, absorbing water and food substances held in solution in it. As a rule, they live for a very short time, being quite absent from the older parts of the root, but as new hairs are continuously being formed behind the growing point as the root grows downwards, a large absorbing surface is always maintained.

C.—Leaves.

The leaf is composed of general ground tissue traversed by vascular bundles, and the whole is covered by an epidermis, all of which are continuous with the corresponding tissues in the stem. The vascular bundles pass into the leaves from the stem without twisting, so that we find the xylem lying towards the upper and the bast towards the lower face of the leaf respectively. On entering the leaf, the vascular bundles, instead of running along definite lines as in roots and stems, branch and rebranch in various ways, traversing the general ground tissue as veins; as they pass into the smaller veins or veinlets, however, they lose all the xylem and bast elements of a typical bundle with the exception of one or two small spiral vessels or tracheids. The bast elements also undergo reduction as the end of the bundle is approached, the sieve tubes and companion cells being replaced by single long cells which extend as far as the xylem elements.

The bundles are closed, there being no need, in members of such limited growth as leaves, for a cambium actively producing wood and bast.

Epidermis.—The epidermis, with few exceptions, consists of a single layer of cells which fit closely together without any intercellular spaces, except that here and there special openings occur. These are the stomata (Plate 210), and if the epidermis be removed and examined

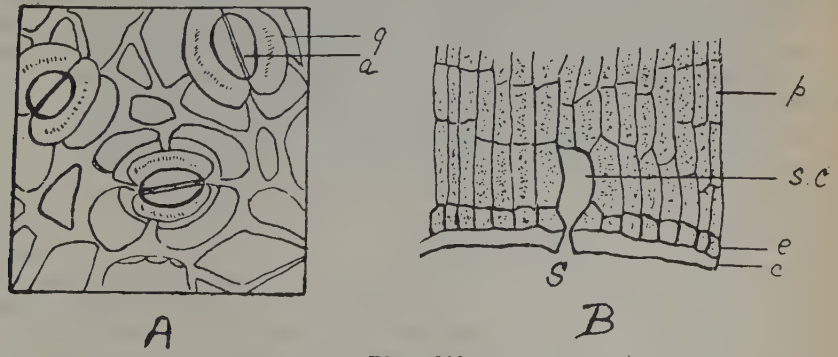


Plate 210.

Stomata on Leaves of Eucalyptus.

A.—Surface view. B.—In longitudinal section.

a, aperture; *c*, cuticle; *e*, epidermis; *g*, guard cells; *p*, palisade parenchyma; *s.* stoma; *s.c.*, substomatal cavity.

[Adapted from illustrations in F. V. Mueller's "Eucalyptographia."]

under the microscope each stoma will be seen to consist of two sausage-shaped cells—termed guard-cells—lying lengthwise alongside one another, with a narrow slit or small opening—the aperture—between them.

The guard-cells can alter their form so as to increase or decrease the size of the opening, closure of the aperture acting as a means of preventing excessive evaporation; thus the stomata play a most important part in regulating the amount of water-vapour given off by the plant, and naturally indirectly, if not directly, act in response to varying conditions of the atmosphere. They also act as a means of communication between the internal tissues and the external air, each opening into a substomatal cavity or air-chamber which is in communication with the intercellular spaces in the ground tissue.

The stomata, though they may occur on the softer parts of stems, are, practically speaking, confined to the leaves and principally to the under surface, the upper surface of the leaf in most plants possessing none or very few stomata. In leaves placed vertically, however, as in many Australian trees—e.g., adult leaves of Eucalyptus, phyllodes of Wattles, &c.—the stomata are equally distributed on both surfaces.

In the leaves of plants which naturally grow in dry country, the stomata—evidently with the object of conserving the water moisture within the plant—are protected in various ways. This may be effected either by the natural clothing of the plant, by being sunken in little cavities or crypts, as in some Honeysuckles (*Banksia*), or they may be protected by the rolling back of the edge of the leaf, leaving only the midrib exposed on the under surface, as in the Wedding Bush (*Ricinocarpus*), &c.

Ground Tissue.—The general ground tissue of the leaf is termed the mesophyll, and in the ordinary type of leaf is usually marked off into two distinct regions—(*a*) the palisade tissue in the upper part, and (*b*) the spongy tissue in the lower.

The palisade tissue is composed of one or more layers of elongated, somewhat columnar cells lying closely packed together, with none or few intercellular spaces between them; the spongy tissue, on the other hand, is composed of loosely-packed cells of very irregular form, and with numerous comparatively large intercellular spaces between them. All the cells of both the palisade and spongy parenchyma are provided with chloroplasts; they are, however, more abundantly produced in the former than in the latter, which, together with the absence of large intercellular spaces, accounts for the generally prevailing deeper colour of leaves on the upper than on the lower surface.

In leaves with a vertical position, such as those of Eucalyptus, the palisade tissue, in place of being developed only towards one surface, is equally developed on both sides of the leaf, with the spongy tissue occupying a strip in the middle. The same condition is seen in the leaves of some Tea Trees, phyllodes of Wattles, &c. A similar structure is seen in terete leaves, such as those of the needle-leaved species of Hakea, the round phyllodes of certain Wattles, &c., but here the palisade tissue encircles a central mass of spongy parenchyma.

Leaves of Conifers.—The leaves of Conifers show marked differences in structure from those of other trees (Angiosperms). The leaf of any common pine (*Pinus*) may be taken as a type, and, though other genera show considerable diversity from this, the same general characters are

more or less retained through the whole family. The epidermis consists of a single layer of thick-walled cells interrupted here and there by the stomata; the guard-cells are sunk slightly below the level of the epidermal ones and open into a cavity. Immediately below the epidermis is the hypodermis, consisting of a layer or layers of strong cells particularly well developed at the corners of the leaf and interrupted at the stomata. The general ground tissue is not differentiated into palisade and spongy parenchyma, and the cells, which are rich in chloroplasts, as in the leaves of other plants are packed closely together without large air spaces. Situated in the mesophyll are a number of resin-passages. Situated approximately in the centre of the leaf are two vascular bundles embedded in a mass of parenchymatous tissue containing no chlorophyll; this is the many-layered pericycle, and the whole is surrounded by a more or less conspicuous endodermis, or bundle-sheath.

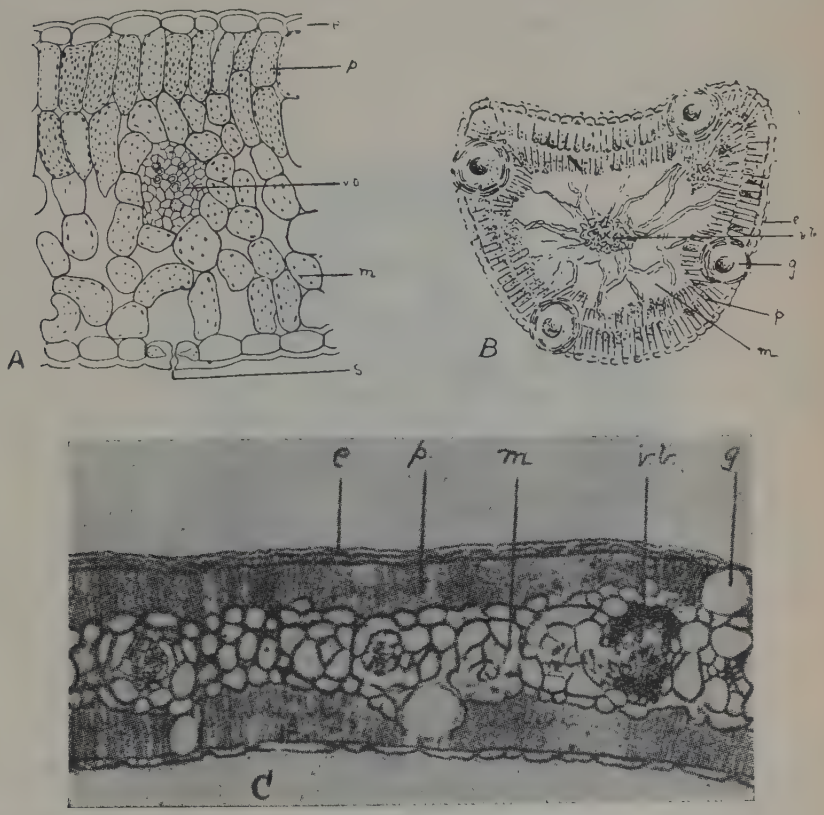


Plate 211.

Leaves in Transverse Section.

A.—Ordinary bifacial or broad-leaved type (after Smith and Smith in Bulletin No. 218, College of Agriculture, University of California, U.S.A.).

B.—*Darwinia fascicularis*, round or centric type.

C.—*Melaleuca genistifolia*, isobilateral type. (*B.* and *C.* after Baker and Smith in the "Journal and Proceedings of the Royal Society of New South Wales.")

e, epidermis; *g*, oil-glands; *m*, mesophyll or spongy tissue; *p*, palisade cells; *s*, stoma; *v.b.*, vascular bundle.

[All figures enlarged to a considerable extent.]

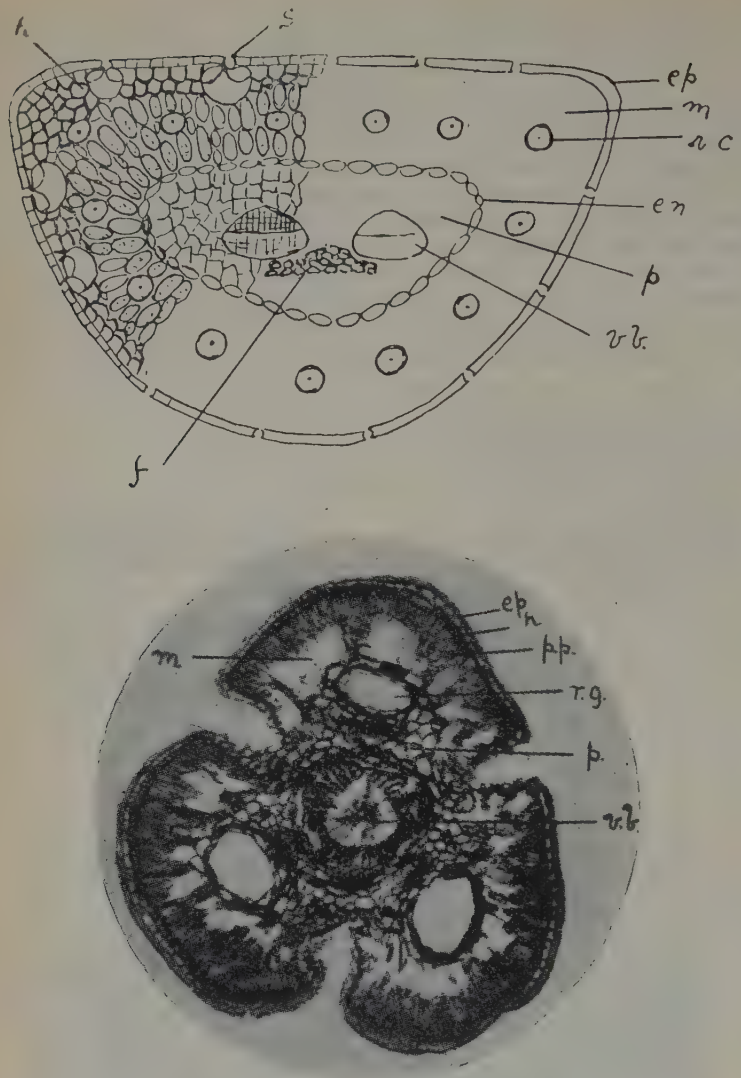


Plate 212.

Leaves of Conifers.

Top Figure: Transverse section (diagrammatic) through leaf of a Pine (*Pinus sp.*) Bottom Figure: Transverse section through the decurrent portion of a whorl of three leaves in an Australian Cypress (*Callitris*).

en, endodermis; *ep*, epidermis; *f*, pericycle fibres; *h*, hypodermis; *m*, mesophyll; *p*, pericycle; *r.c.*, resin canal; *s*, stoma; *v.b.*, vascular bundle.

[Both figures enlarged to a considerable extent. Bottom figure after Baker and Smith.]

As previously stated, other Conifers show considerable diversity from this type. The anatomy of the Australian Conifers has been closely investigated and described by Messrs. Baker and Smith, who give detailed accounts of the different genera in their work—"A Research on the Pines of Australia" (Sydney, 1910).

In *Callitris* (Australian Cypress Pines), the commonest and most widely spread genus, these authors have shown that the leaves—which occur in whorls of three—are for the greater part of their length decurrent on the branchlets; the stomata are confined to the ventral surfaces, being found in the grooves formed by the decurrent leaves, the epidermis consists of one or rarely more rows of epidermal cells, and immediately below the epidermis is a one or two layered hypodermis. The cuticle changes in character on different parts, on the back or outer edge of the leaf it being of the ordinary type, but on the vertical surfaces—i.e., where the stomata are situated—it becomes broken or changes into little papillose projections, whose function is probably to act as secondary guard-cells to the stomata. The mesophyll is differentiated into palisade and spongy parenchyma, and in the centre of the latter occurs in each leaf one usually large oil-cavity. The leaves themselves contain no vascular bundles, but in the centre of the branchlet on which they are decurrent are three wedge-shaped bundles surrounded by an endodermis and accompanied by more or less transfusion tissue.

Fall of Leaves.—When leaves are about to be shed, a layer of cork is formed at the base of the leaf-stalk and continuous with the periderm of the stem. The fall of the leaf is due to a layer of cells situated at the base of the leaf-stalk and immediately above the recently formed cork-layer becoming disorganised owing to the stoppage by the cork-layer of supplies of moisture from the stem. When the leaf falls, the cork layer that was formed protects the internal parts of the stem from injury, and, further, the cavities of the sieve tubes and vessels may become sealed with gum or cork.

On the scar left on the branch by the fall of the leaf may be seen the closed ends of the vascular bundles which originally ran from the stem to the leaf. The shape of the scar and the distribution of the bundles vary with the different species, and the leaf scars on a twig are often useful guides in helping to determine the species to which the twig belongs.

D.—Development of Secondary Members.

Young shoots first make their appearance on the growing points as minute humps, due to the growth and division of actively dividing cells. As these grow, the young epidermis increases in area, but as its cells divide in one direction only—viz., at right angles to the surface—it does not increase in thickness.

Young secondary roots do not arise in the superficial tissues, but originate in the fundamental tissue of the parent root.

When a young root is about to be formed, certain cells become meristematic and a growing point is produced. The young root has to bore its way through the tissues lying between it and the exterior of the parent root; this is accomplished, not by purely mechanical means, but by chemical action. Certain cells of the epidermis and sometimes one or two layers of the cortex form a sort of cap over the growing point; the cap so formed is known as the digestive sac, because its cells secrete a ferment which breaks down or digests the walls of the overlying cells so that the young root is able to reach the surface.

[TO BE CONTINUED.]

Some Peculiar Feeding Habits of Stock and What They Indicate.

W. R. WINKS, B.Sc., A.A.C.I., Analyst, Agricultural Chemist's Laboratory.*

IN order to study peculiar feeding habits of stock, it is necessary to have some idea of what has been going on in our pastures since man first introduced sheep and cattle into areas previously supporting only native animals.

The original pastures grew, died, and decayed, and on decaying returned to the soil the mineral matter taken from it during their period of growth. Along with the mineral matter, which is derived entirely from the soil, nitrogenous matter derived partly from the soil and partly from the air also found its way back to the soil to supply later pastures with their necessary food. The virgin grass lands thus became increasingly fertile, as practically nothing was being removed from them, and extra nitrogen from the air was being added to them. Long years of grazing have brought about many changes. Instead of the vegetation decaying and being returned to the soil, it is consumed by the stock, the non-digestible portion being returned with the excreta, but much of the mineral matter goes to form the skeleton of the animal and the other organic matter to build the body.

It may be explained here that the ash of the grass consists of the mineral matter, while that portion which burns away is the organic portion. When the animal is sold the elements derived from the soil are removed with it, and no corresponding replacement takes place. With the death of the animal the nitrogenous matter is quickly returned to the soil, but the mineral of the bones only becomes available over a fairly long period.

Add to these factors the cutting up of the ground surface by the hooves of the stock and the consequent surface erosion, and it will be evident that our soils are gradually being depleted of their available mineral plant food, and this depletion must be reflected in the pastures themselves.

We now find the animals which depend on these depleted pastures for their existence eating substances altogether foreign to their natural diet, and it is these peculiar feeding habits that form the subject of this article.

The first peculiarity that we will notice is the bone-chewing habit.

This habit is quite common on many of our Australian stations and dairy farms, but for a long time did not cause any serious concern to the stockowner, although it seems to have been early recognised that it indicated some deficiency in the natural pastures. It does not seem to have been recognised until recently in Queensland that bone-chewing, or rather its causes, could have anything to do with the unthrifty condition of stock.

Bones consist for the most part of calcium phosphate or, popularly "phosphate of lime," and bone chewing would naturally lead one to suspect that a deficiency of either lime or phosphorus in the pastures is indicated. Phosphorus is an element which is not very abundant in most of our Queensland soils, and the factors indicated in the opening paragraphs of this paper would tend to bring about an actual deficiency

* In a broadcast talk from Radio Station 4QG, Brisbane, through the courtesy of the Australian Broadcasting Commission.

of this element after years of grazing and removal of stock, even where phosphorus deficiency did not originally exist.

By chewing bones the animal attempts to obtain that supply of phosphatic material so necessary for the building of the skeleton, and if the bones have been thoroughly weathered some benefits may even result from the habit, but if the bones are not cleaned by the weather, but have scraps of decayed flesh adhering, sickness and death may result.

A disease known in South Africa as Lamsiekte, which results from the chewing of bones with adhering carcase debris, was the cause of serious stock losses until Sir Arnold Theiler in 1920 demonstrated that the disease was indirectly caused by phosphorus deficiency, and the feeding of phosphatic licks was found, not only a preventive of the disease, but also resulted, to quote Sir Arnold Theiler, in "Increase of milk yield of cows, better calves at birth, more rapid growth of young stock, and superior fattening of adult cattle."

"Indeed, by focusing attention upon specific nutritional deficiencies of South African veld, the disease (Lamsiekte) can almost be said to be a 'blessing in disguise.' "

The habit of bone chewing thus indicates phosphorus deficiency, and it can be cured by feeding phosphatic licks.

That phosphate feeding is a payable proposition can best be indicated by quoting again from Sir Arnold Theiler in "Phosphorus in the Live Stock Industry," when he concludes: "In all areas where the soil and pastures are known to be deficient in phosphorus, it is profitable to feed bone-meal to practically all stock for the sake of improving condition and facilitating rapid growth. For cattle it is particularly advisable since two important diseases, lamsiekte and styfsiekte, can be prevented by liberal bone-meal feeding. When insurance against disease, increased beef production, increased milk yield, and more rapid growth of young cattle are all taken into consideration, it will be found that any expenditure on bone-meal is repaid many times over."

The next peculiar habit to claim our attention is that of flesh or carrion eating.

This habit has been mentioned as incidental to the bone chewing habit, when adhering carcase debris was found to be eaten along with the bones. In the "Journal of the Council of Scientific and Industrial Research, 1933," we find the statement that, "Botulism, i.e., 'Ptomaine Poisoning' in sheep is now being regarded as being a source of greater economic loss than all other diseases affecting sheep in Western Australia. It is due to the ingestion of toxic rabbit carrion." Later we have in the same journal the statement by Mr. D. Murnane that "both cattle and sheep have been observed to eat raw flesh," and also that "in parts of South Australia cows have been seen eating unskinned rabbits in traps, and sheep eating dead sheep and 'goannas.' "

The habit of carrion-chewing leads to loss from what is popularly known as "ptomaine poisoning," and, if only for this reason, an endeavour should be made to overcome the depravity.

It has been proved that any long-continued deficiency can cause almost any peculiar habit, but an investigation of the cause of carrion eating by Mr. Murnane led to the conclusion that "sheep kept on a diet low in protein will eventually resort to flesh eating to correct the

deficiency," and that "the return to a ration containing an adequate supply of protein soon overcame the depravity."

Flesh or carrion eating has not been reported as a serious disorder in Queensland, but what resembles this depravity occurs in the Maranoa district. This is what is known in the district as caterpillar eating, but is really the eating of the larvae of the sawfly. The sawfly larvae feed on the leaves of the silver-leaf ironbarks, and come to the earth to pupate. In times when the larvæ are plentiful the trees are stripped of their leaves, and the starving larvæ fall to the ground and perish. They are eaten both in the live and dead state by cattle, and cause death in less than twenty-four hours.

The cause of this habit is being investigated, but there are many apparently contradictory aspects of the problem which render a positive diagnosis of the cause, at the present time, a matter of difficulty.

There are indications, however, that this habit may be due to phosphorus or protein deficiency, and if so the use of phosphatic licks and a protein concentrate such as linseed, or cottonseed meal, should help to overcome the trouble. This could be tried with advantage during the outbreak that is threatening at the present time.

The dirt-eating habit is the next to come before us in this paper, and this habit is probably more prevalent amongst stock than is generally recognised.

Dirt or soil is a very complex mineral substance, and may contain practically all the known elements, so that the lack of any element may be responsible for this habit.

When the fact that animals did eat dirt was first recognised, it was generally thought that salt was the substance lacking. This was probably due to the fact that salt is often present in sandstones licked by stock, but in parts of Queensland stock have been observed to leave salt troughs and eat mud from creek banks, indicating that in some cases at least salt is not the mineral that is deficient. In this same district the ashes of burnt logs are eaten with evident relish.

The dirt-eating habit may, however, be the result of phosphorus deficiency, or of a deficiency of iron, lime, or other mineral matter.

The foregoing will serve to show that peculiar feeding habits of stock generally indicate a deficiency in their feed, which may lead to actual death or at least retard the growth of the animal.

STAGGER WEED AND MINT WEED.

At the present time stagger weed is beginning to evidence itself as a weed of cultivation in southern Queensland, and every winter and spring large numbers of specimens are received from farmers who are under the impression it may be the mint weed that has been proved by feeding tests to be poisonous to stock, and in consequence areas of winter feed badly infested with this weed are often withheld from feeding off.

Though frequently called mint weed, and wild mint as well as stagger weed, it can be distinguished from the poisonous variety in being of a more or less yellow-green rather than sage-green colour, and having short, round, not narrow leaves.

Stagger weed is only harmful when fed to working horses or travelling stock, animals having to be excited in some way before any effects are noted. As indicated by the local name the symptoms of disorder are a marked twitching, shivering, and staggering. Ordinarily resting stock, such as dairy cows and calves, are unaffected by the weed.

Dairy Winter Fodder Trials, Mackay District.

Mr. C. S. Clydesdale, Senior Instructor in Agriculture, reports (21*st August,* 1936) :—

THE experiments were established with the view of demonstrating to the dairy farmers throughout the Mackay district that the growing of these crops during the winter months can be carried out successfully, thereby supplementing pastures to tide their dairy herds over the leaner periods of the year.

At this season of the year feeding becomes necessary, due to the fact that the natural pastures become dry and of little value to cows in full profit.

Again, values for cream usually rise, and to receive the full benefit of these high prices it is necessary that some class of succulent feed be supplemented to gain the full advantage of this increase. Further, if this practice is followed, the cows will be kept in good condition during the cold months, and it may be expected normally that an increase in supplies will be forthcoming immediately when fresh growth is made by the natural grasses.

Under ordinary conditions, where no provision is made for winter feeding, the cows become low and weak, and some months elapse before they are back to normal.

The experiments conducted were designed to ascertain the most suitable crops or crop mixtures for the district, and to demonstrate that the methods, as practised, were within the reach of all dairy farmers.

The plots were arranged for on the property of Mr. E. S. Abell, Blue Mountain. The land selected was forest, and is a deep alluvial type of light-brown loam, which has been under crop for the last two years. As there is no official rain-gauge in this district, the nearest station, Sarina, is quoted. The approximate distance being twenty miles, some variation in the precipitations may be expected, due to the fact that Blue Mountain is approximately 1,000 feet above Sarina.

RAINFALL, SARINA.

Month.	Points.	Wet Days.
January	986 ..	19
February	3,870 ..	21
March	2,904 ..	19
April	53 ..	5
May	183 ..	9
June	833 ..	12
July	58 ..	8

The heavy falls experienced during February and March, amounting to 67·74 points, caused considerable damage and delay in getting the land prepared for the experiment.

It was originally intended to plant out the plot during the latter end of March or early in April, but this work was not carried out until the first week in May, which, under the circumstances, was rather late to expect early supplies of winter feed.

The area comprising 2 acres with eight plots each ¼ acre was planted with the following varieties, viz.:—Florence wheat, skinless barley, belah oats, and canary seed, while in the remaining plots these cereals were planted with a mixture of Dun field peas.

The weight of the seed planted, in the order named above, was 45 lb., 40 lb., 40 lb., and 10 lb. per acre, while the four mixture plots contained the following weights per acre:—Florence wheat 30 lb., peas 20 lb.; skinless barley 30 lb., peas 20 lb.; belah oats 30 lb., peas 20 lb.; canary seed 7 lb., peas 20 lb. The total cost of the seed for the eight ¼-acre plots aggregating 2 acres was 11s. 9d., the seed for the four straight plots costing 5s. 2d., and that for the four mixture areas 6s. 7d., excluding freight from Brisbane.



Plate 213.

Crop of Florence wheat. Planted 7th May, 1936. Photographed 28th July, 1936. Green weight 13 tons 10 cwt. per acre.

Cultivation.—The land was prepared as soon as conditions became favourable for the work. Ploughed early in April with the single disc plough, and harrowed; towards the end of April cross-ploughed and harrowed, and prior to planting was reduced to a fine tilth by means of a spring tooth cultivator harrow and roller.

In the sowing of the seed the usual practice of broadcasting was followed, as no seed drill was available. When used in mixtures the pea was sown first and a spring tooth used so as to give a good covering, and the cereals then sown, harrowed, and rolled. This practice gave a good covering and compacted the soil, which resulted in a good germination.

All varieties made a quick, flush growth, and, with the exception of skinless barley, were particularly free from rust.

From the period of planting, viz., 7th May until the time when weights were taken on the 10th August—fourteen weeks—the wheat



Plate 214.

Crop of Belah oats and Dun field peas. Planted 7th May. Photographed 28th July, 1936. Green weight 16 tons 5 cwt. per acre.



Plate 215.

Crop of Belah oats and Dun field peas. Planted 7th May. Photographed 28th July, 1936. Green weight 16 tons 5 cwt. per acre.

proved to be the most advanced. It had attained a height of 5 feet, was perfectly healthy, and full of body in the foliage. It had just reached the stage when the grain was beginning the form in the glume, and within a week or two would reach its zenith as a green feed.

Remarkable growth was shown also by the plots containing oats alone and oats with peas, the last named giving a return of the highest tonnage on the acreage basis.

A description of the plots is as follows:—

Florence Wheat.—This crop made a very flush growth and attained a height of 5 feet, and was free from all traces of rust; the flag was broad and when inspected was just coming into flower.



Plate 216.

Canary seed and Dun field peas. Planted 7th May, 1936. Photographed 28th July, 1936. Green weight 11 tons 5 cwt. per acre.

Wheat and Peas.—This crop presented a wonderful appearance, as the peas grew to the full height of the wheat and were out in flower, indicating that this mixture would be a more balanced ration than the wheat sown alone.

Belah Oats.—This variety made rather quick growth, and when inspected was 4 feet in height, and only an odd plant appeared in the shot-blade stage. Dark green in colour, broad flag, rather fine in the stem, and exceptionally free from rust.

Oats and Peas.—Again the peas made a flush growth, and were noticeable throughout the whole area in flower.

Skinless Barley.—During the early stage rust appeared and the growth was stunted, with the result that from a feeding point of view this crop was of little value. When inspected it was only 18 inches high and commencing to die back.

Canary Seed.—This was much slower in growth than the other varieties, and when inspected was about 1 foot high. The stooling was very good, flag broad, and the stem inclined to be large but not coarse.

Canary Seed and Peas.—The peas were much quicker in growth, and practically had possession of the area. Showed good feeding qualities.

In calculating the weights, two portions each one square yard were taken from an average of the plot, and all vegetation on each area cut at mowing level and weighed. The average of these two weights were taken as a basis of the weights to the acre.

	Tons	cwt.
Florence wheat	13	10
Florence wheat and peas	13	0
Skinless barley	6	10
Skinless barley and peas	8	10
Belah oats	14	10
Belah oats and peas	16	5
Canary seed	11	0
Canary seed and peas	11	5

On 10th August a field day was arranged, and quite a number of farmers attended.

A GOOD LITTER OF PIGS.

The litter record shown here was checked officially at Mr. W. T. Tatnell's farm, Gympie, and is considered very satisfactory.

This was the first litter of the sow "Glenroy Viola"; ten pigs were born and nine reared to eight weeks old, one pig being accidentally killed when two weeks old.

LITTER RECORD.

Owner.—W. T. Tatnell, Greenbank Stud, Cedar Pocket, Gympie.

Dam of Litter.—Tamworth, Glenroy Viola.

Sire of Litter.—Tamworth, Wattledale Clinker.

Litter Born on.—10th June, 1936.

Tattoos .. / Sexes ..	1 B	2 B	3 B	4 B	5 B	1 S	2 S	3 S	4 S	5 S	Total.	Average.
Weight at— Birth ..	Lb. 3	Lb. 2	Lb. 3	Lb. 2	Lb. 2	Lb. 2½	Lb. 2½	Lb. 3½	Lb. 2½	Lb. 2½	Lb. 25½	Lb. 2·5
1 week ..	5	5	5	4½	3½	4½	4½	4½	4½	4	45	4·5
2 weeks..	7½	7	7	6½	6	7	7½	6½	7	5	67	6·7
3 weeks..	11	9½	10	9½	8	8½	10½		9	7½	83½	9·2
4 weeks..	13½	13	13½	13½	11½	12	14		12	10	113	12·5
5 weeks..	19	18	20	18	16½	17	19½	Accidently Killed.	18	16½	162½	18·0
6 weeks..	26	24½	25	25	23	23	28½		22½	19	216½	24·0
7 weeks..	31	25½	28	28	27	24½	31		28	24	247	27·4
8 weeks..	42	33	35	35	36	33	39		31	29	313	34·7



PIGS FOR PORK AND PIGS FOR BACON.

L. A. DOWNEY, H.D.A., Instructor in Pig Raising.*

THE question most frequently asked by pig breeders is "What is the best breed of pig to use?" and one might as well ask "What is the best make of motor truck to use?" for the answer depends on circumstances, including the purpose for which the pig or the motor truck is required; a two-ton tip truck is not suitable for light parcel delivery in the city, nor is a Large White pig suitable for a 60-lb. porker.

Having decided on the purpose for which his pigs are to be grown, it is possible for the breeder to select a breed or cross to suit his needs, but in Australia we are faced with a vast problem which must be attacked in a broadminded manner. Pig production in Australia has increased to such an extent in recent years that we have an exportable surplus over local requirements, and most of that surplus is being sold in Great Britain, and as we consider there is still room for expansion of our pig industry, we hope to sell more pork on the English markets, which are the most important importing markets in the world for pig products. Competition is keen on the markets of Great Britain, and so Australia is keen to export the highest quality pork.

Whilst there is a demand in England for pork and bacon pig carcasses weighing from 50 lb. to 200 lb., the greatest demand is for pigs weighing 60 to 80 lb. for pork and those weighing 130 to 160 lb. for bacon. In Australia, bacon factories prefer pigs for our local trade weighing 100 to 120 lb. dressed. Thus there are three optimum weight ranges for pig carcasses. Although weight is the primary consideration in the sale of pig carcasses, conformation and condition, which is influenced largely by the amount of fat the carcass carries, are very important considerations. For the light pork, light bacon, or heavy bacon trades, the same general conformation and proportions of fat to lean are required, the weights only being different.

A prime light porker should weigh between 60 and 80 lb. and have half an inch of back fat over the thinnest portion at the loin and not much more over the shoulder, it should have good length of middle in comparison to its weight, the hind legs should be well fleshed, and the forequarters, head, and neck should be comparatively light; briefly, the

* In a broadcast talk from Radio Stations 4QG, Brisbane, and 4RK, Rockhampton, by courtesy of the Australian Broadcasting Commission.

carcass should carry a large proportion of lean meat and a large proportion of the more valuable cuts, which are the middle piece and the hind legs. In this condition a pig is referred to as being finished, but not overfattened.

The light baconer should have the same degree of finish and similar conformation at 100 to 120 lb. dressed weight, its backfat measuring three-quarters of an inch over the loin. The heavier baconer, which is used in England for curing as Wiltshire sides, should also have the same relative conformation and proportion of fat to lean, but it should reach its finished condition at 130 to 160 lb. dressed weight, and have one inch to one and one-quarter inches of fat over the loin.

Now it should be realised that during its growth a pig increases in bone, muscle, and fat, but in the very early stage, about weaning time, the bony skeleton increases out of proportion to the muscle and fat; then a stage is reached during which the muscle increases at a greater rate than the bone and fat; and then, as the pig approaches maturity, it lays on fat very rapidly and the growth of bone and muscle is retarded. To secure that desirable balance between muscle, fat, and bone, which gives a prime carcass, it is necessary to slaughter the pig when it has covered its frame with muscle and before the fat has increased too much. These stages of development are called maturity, and maturity in pigs is not the rate of growth, but the development towards that stage when fat is deposited in the carcass at a very rapid rate. An animal may grow rapidly and yet be late in maturing, which means that it does not deposit much fat on its body until it is relatively old and of a heavy weight.

Different types of pigs mature at different weights, and so the pig raiser, who knows the class of carcass required by the particular trade for which he is catering, is able to select breeding stock of a type to give porkers or baconers maturing at the most desirable weights, or conversely to have his pigs in a finished condition when they reach marketing weights. The rate of maturing of pigs varies widely, but for convenience we may consider three classes or types:—

(1) That type which is "finished" at light porker weights;

(2) That which is "finished" at light baconer weights, and

(3) That which is "finished" at Wiltshire baconer weights.

While it is possible for a pig raiser to take any one of these three types of breeding stock and turn their progeny into prime finished pigs at light pork, light bacon, or heavy bacon weights, it is either uneconomical or impracticable for the average pig raiser to do so under average conditions, and therefore we must select a particular type of breeding stock to suit each particular market class.

Rate of maturity is usually indicated by size in mature breeding pigs, and thus we refer to small, medium, and large types, and we speak of particular breeds as being of one of these types, but it is important to realise that there is a big variation of type within breeds as there is between breeds, and in selecting stock the breeder must be able to recognise type irrespective of breed. By selection it is a comparatively simple matter to change the type of a breed; examples of this can be seen in the Berkshire breed, which may vary from a porker type in the average Australian Berkshire to a large bacon type in the Canadian Berkshire. The Tamworth breed until a few years ago was considered large bacon type, but the present Tamworth is of the medium type

suitable for the production of light baconers. These changes in type within a breed are due to the selection of types which occur from environmental influences and natural variation.

Feeding and environment will alter somewhat the rate of maturity in pigs, full feeding and limited exercise causing pigs to fatten at lighter weights, but inherited type has the greatest influence on the maturity, and therefore it is essential that pig raisers should use the correct type of breeding stock, for a typical porker is an overfat and chubby pig when he reaches bacon weights and a typical bacon pig is bony and unfinished when he is at pork weight, and the same differences apply between light and heavy baconers.

Considering the variations in type within breeds, it is difficult to classify breeds, but as a general guide to farmers, I would suggest that Berkshires and Middle Whites are mostly small porker type, Tamworths are mostly light baconer type, and Large Whites are typical English bacon type. Crosses between these breeds may be used; for example, the Large White crossed with the Berkshire or Middle White gives a medium type pig to suit the light bacon trade.

Mention should be made of the Tamworth-Berkshire cross which has been famous for producing a light bacon pig, but with the change in the Tamworth in recent years making it a smaller and quicker maturing pig, this cross is now finished at about 90 lb. dressed weight, and we find the Tamworth being used pure for light-weight baconers.

Pig raisers must visualise the classes of pigs required by various trades, they must then be capable of recognising type, irrespective of breed characteristics such as colour, and remember that there are pigs for pork and pigs for bacon, and unfortunately there is no such thing as an ideal dual purpose pig.

A BUSH CHAIR.

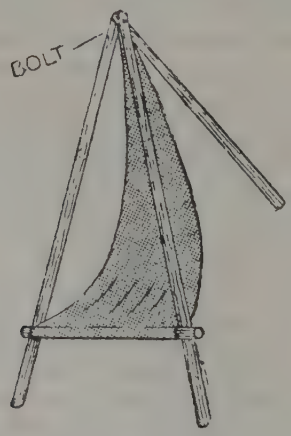


Plate 217.

Four lengths of wood, a bolt and a cornsack are all that is needed to make this comfortable bush chair. Bolt three pieces of wood together at the top to form a tripod. Fasten the fourth piece across two of the pieces at a suitable height from the floor and tack or sew one end of the sacking to this piece and the other to top of the chair.



UNSETTLED weather prevailed during the first week of September, resulting in some substantial falls on the far north coast, although elsewhere falls were of a light and scattered nature. On 8th September, welcome storm rains occurred in the South-East and Downs, many centres in the latter area receiving over an inch. At the time of writing (18th September), indications point to further storms which will be of great benefit to growing crops.

Wheat.

After an almost total absence of rain during August, available moisture resources were rapidily nearing exhaustion, so that the rains referred to above may be said to have saved the crop at a critical stage of its growth. Where the land was summer fallowed, and due attention paid to the subsequent cultivation, satisfactory growth has been in evidence, and growers are assured of satisfactory yields. Hurriedly prepared land has to depend entirely on seasonal rains, and as August and September are usually comparatively dry months fallowing is essential if high average returns are to be secured.

The estimated acreage sown, 335,000, is approximately 35,000 acres in excess of the previous season, and given favourable conditions during the present month and October, an over average crop can be confidently anticipated.

Lucerne for Grazing.

This plant is usually associated with rich alluvial flats, and districts possessing a high rainfall, where its response to such good conditions renders it the most profitable crop to grow. During recent years it has been found that lucerne will thrive under a much wider range of soil and climatic conditions in both New South Wales and Queensland, where the possibilities of utilising it as a grazing crop are now being explored.

Mr. C. H. Defries, Instructor in Agriculture, Roma, reports that Mr. Woodside, of Guluguba, now has 300 acres under lucerne on the box flat country adjacent to Jundah Creek, and that he has been fattening steers at a time when the district generally has been suffering from a severe dry spell. The oldest stand on this property is five years, and its growth is still vigorous. It is not surprising that in view of this

success Mr. Woodside intends to sow a further 100 acres of lucerne. The heavier clays and light pine lands of the Maranoa are naturally unsuitable for lucerne, but good stands have been established in brigalow and belah scrubs. Where soil conditions permit, lucerne will be found an excellent crop for old wheat lands. The chief difficulty lies in securing a good germination, which renders it necessary to make autumn sowings on thoroughly cultivated land. Heavy seeding is not required, as 3 to 4 lb. of sound seed per acre will be found sufficient for grazing purposes in the drier agricultural areas.

Tobacco.

In all districts tobacco growers are preparing their land for the coming season's operations, and indications are that, providing the season is a normal one, increased acreages will be placed under crop. In view of the fact that better quality leaf and yields are being obtained on virgin land, large areas are being cleared and ploughed.

Following the successful protection of tobacco seedlings from blue mould by use of volatile gases, such as benzol, toluol, &c., vapour treatment demonstrations are to be conducted in the principal growing centres during the next few months. It should be realised that gas treatment varies greatly from fungicidal spray treatment in that the former is much more likely to be influenced by the environment in which the work is carried out. The concentration of vapour, and hence its efficiency when a certain amount of liquid is exposed is influenced by the prevailing temperature as well as the size of the covering over the bed, and the gas-tightness of the material of which it is constructed. Hence one may expect varying degrees of success at first when this method is adopted on farms, depending on seasonal conditions, and care given to the construction of beds, and regularity of treatment.

Cotton.

The harvesting of the cotton crop has continued at a surprisingly good rate during the past month, bringing the total for the season to the 24th September, to 13,383 bales, 9,406 of which were ginned at Glenmore and 3,977 at Whinstanes. The grades obtained in the late crop have been particularly good, the continuance of the dry windy conditions having allowed the top bolls to be harvested in a very satisfactory condition for cleaning up efficiently in the ginnery operations, while the lack of rain has resulted in most of the cotton being of good colour.

Seed distribution for the coming crop has continued at a good rate, the total issued to the 18th September being sufficient to plant at least 40,000 acres. The greater proportion of this seed has been of the varieties producing the short to medium staple harder bodied cottons now in demand by the Australian spinners. Reports from most districts indicate that preparation of seed beds is well advanced, considering the dry conditions that have ruled. Good rains at an early date are desirable, however, not only to enable planting to be started in the Central district, but also to ensure of completion of seed bed preparation in all districts to enable the whole of the crop to get off to a timely start.

Sugar.

Rainfall in all cane areas was decidedly subnormal throughout September. In the far northern areas this was something of an advantage, for it brought about a substantial improvement in the sugar content of the mature crop, while not seriously handicapping the young cane.

In the Mackay district rain is urgently required to assist the growing crop, while the Southern districts are passing through a serious drought, which threatens the spring plant cane and young ratoons; unless early rains are received in these parts, the 1937 harvest prospects will be seriously jeopardised.

BEAN ANTHRACNOSE.

Some recent consignments of beans to the Brisbane markets have been badly affected with anthracnose. This disease produces dark-brown, sunken spots on the pods which, under moist conditions, develop a flesh-coloured area in the centre. This latter consists of a mass of fungus spores by means of which the disease is spread. These spots may be found in the field, or they may develop on an apparently healthy bean after it has been bagged.

In the field, in addition to the pod, other parts of the plant are affected. The veins on the lower surface of the leaves may be killed and blackened. On the stem the disease may appear as sunken spots very similar to those found on the pods. In wet weather spores are formed on these lesions, and it is by this means that the disease is spread through a young crop.

The fungus causing the disease may penetrate the pods and affect the seed. It may or may not produce obvious lesions on the seed, and thus diseased seed may be planted without a knowledge of its condition. When such affected seed is planted, the fungus forms the characteristic lesions on the young seedling leaves and on the base of the stems, and from these the disease spreads very quickly through the crop in wet weather.

As can be seen from the above description, the disease is carried from season to season on the seed, and affected seed may introduce the disease to a locality previously free from anthracnose. Thus, a first method of control is to obtain, if possible, seed from a source free from the disease. Failing this, a farmer may select healthy pods from the best areas in his own crop, and the seed can be retained from these. In making this selection care should be taken to eliminate also any plants affected with the bacterial disease, halo blight.

If the crop is diseased, it is well to remove and burn all refuse after the harvesting is completed, as the fungus can live over on the dead and decaying bean leaves in the soil. It is not advisable to plant in low, damp situations, nor to sow too thickly. If a crop in which there are only a few diseased plants is worked while wet with dew or rain, the disease is spread very quickly by means of the spores carried on the clothes and implements.

Spraying a bean crop to combat the disease is not considered to be an economic undertaking, but a small plot kept for the sole purpose of obtaining disease-free seed could be sprayed to some advantage with 4-4-40 Bordeaux mixture.

Whenever possible beans should be picked while the plants are dry. They should always be spread out in a clean place to dry thoroughly before packing or bagging. Any beans showing anthracnose development at the time should be rejected.



FRUITGROWING IN QUEENSLAND.

H. BARNES, Director of Fruit Culture.*

ALMOST every section of the fruitgrowing industry in Queensland offers opportunities for steady expansion, provided it is developed along modern lines.

The Banana.

Banana-growers are recognising that the old haphazard methods of husbandry have passed with the exhaustion of virgin rain forest lands, and are settling down to a system of more intensive cultivation and fertilizing.

Although banana-growing has always been the most important section of the fruit industry in Queensland, its position of prominence will be challenged seriously soon, if present anticipations in respect of pineapple-growing are realised. Pineapples possess advantages over bananas, not the least of which is that they can be canned and kept indefinitely, while bananas must be consumed as fresh fruit.

The Pineapple.

Recent investigations into pineapple matters in Queensland, carried out chiefly by Mr. Lewcock, of the Pathological Branch of the Department, have proved our cultural methods to be in need of a severe overhaul. In Hawaii, the average production per acre is about 500 cases; in Queensland, average production is about 200 cases per acre. The question which arises, naturally, is: Why is Hawaii able to produce such a higher average return—300 cases per acre more—than Queensland is doing? Our soils are quite as suitable for growing pineapples, and growers use large quantities of fertilizers, as is done in Hawaii. In the past, it has been the practice locally to plant pineapples in rows 9 feet apart, using from 5,000 to 8,000 plants to the acre; in Hawaii the rows are planted 6 feet and less apart, and from 12,000 to 16,000 plants are

* In a broadcast talk from Radio Station 4QG (Brisbane) and 4RK (Rockhampton), by courtesy of the Australian Broadcasting Commission.

set to the acre. Mr. Lewcock's experiments have shown that, by reducing the distance between the rows in Queensland and thus planting a greater number of plants per acre, not only is a greater yield of fruit obtained, but, in conjunction with the use of proper fertilizers, a much more vigorous plant growth is established for subsequent crops. The modern method of fertilizing pineapples is not to apply the fertilizer directly to the soil, but to scatter it in the basal leaves of the plants, whence it is washed down to the tiny roots present at the base of each leaf, and thus absorbed directly by the plant. Naturally, only water-soluble fertilizers are of value in this system.

It has also been determined that, contrary to previous belief, an acid soil is most beneficial to successful pineapple-growing, while iron in the soil is essential for healthy growth. The application of sulphur to the land prior to planting supplies both these requirements, in so far that it lowers the p.H. value to a point favourable to pineapple growth and wilt resistance, and makes insoluble iron in the soil available to the plants. Growers who have adopted Mr. Lewcock's recommendations along these lines have demonstrated that it is quite possible locally to at least equal average Hawaiian production.

So far as markets are concerned, Australia is absorbing almost the whole of Queensland's present production, and the demand for the fresh and canned fruit and the various by-products is increasing rapidly each year. The British market also is open to us for the canned product. The present rate of exchange is favourable, and the Sugar Industry Concession Committee has made certain financial contributions which have helped considerably the export of any small surplus in past years. There is no immediate indication that the rate of exchange will operate adversely in the near future, and, even if it did, with greater efficiency in production, the added advantage of at least 100 per cent. better returns per acre would go a long way towards making the industry still a profitable one. That there is a definite market in Great Britain is proved by the results of the efforts made last year by the Committee of Direction of Fruit Marketing. Negotiations were entered into with a large firm of distributors in England to handle Queensland canned pineapple, and within several days orders were placed for three or four times greater quantity than was available, and at a price favourable, under present conditions, to the industry.

Tropical Fruit Salad.

A popular by-product of the Queensland tropical fruit industry, which, during the past two or three years, has met with a big demand, is tropical fruit salad. The salad, which is put up in cans, comprises a blend of several well-known fruits, including pineapples, papaws, passion fruit, and bananas. The salad is delicious, and is certain of a far greater market as it becomes more generally known. The marketing of this product has naturally created a greater outlet for papaws and passion fruit.

The Papaw.

The quality of the fresh papaw is becoming recognised more widely in the Southern States, and the fact that improved transport facilities now enable it to be carried in perfect condition to Melbourne has created an increased demand at good prices.

Passion Fruit.

Passion fruit products are becoming popular in Britain, and are being used in many ways. Cocktail mixers and confectionery manufacturers are using considerably greater quantities of the juice each year, and it is important that Queensland growers should help meet the new demand.

Citrus Fruits.

Production of citrus fruits in this State does not equal local consumption, and considerable quantities are, of necessity, imported each year. Districts where irrigation is available are most suitable for the expansion of production of this fruit, which is very subject to the retarding effects of dry weather.

The Strawberry.

Strawberry-growing is a sound occupation for orchardists with only comparatively small farms. An excellent outlet exists for this berry, both in its fresh state and for factory purposes. Fresh berries are now being forwarded successfully to Victorian markets, where good returns are received.

Some newer branches of fruit production in Queensland which call for more attention by orchardists are macadamia nuts, avocados, mangoes, and dates.

The Australian Nut.

That the macadamia is the finest nut grown in the world has become a much-used phrase during the past few years among those closely associated with the development of this branch of horticulture. It is true, nevertheless. There are markets for macadamias in several parts of the world. The old argument that the hard thick shell would always have a detrimental effect on its popularity has been put on one side by the discovery of natural thin-shell types growing in coastal scrub lands. Several types of crackers have also been invented, the latest of which is claimed to crack a hundred nuts per second without damaging the kernels. With the existing demand, the two or three hundred acres which it is estimated are now being grown cannot hope to supply the market when they come into bearing, and there is room for many more trees.

The Avocado.

The avocado is a fruit still unfamiliar to most people, who, when they first taste it, are not keen on its flavour. Those, however, who know the avocado well will assure them that at the second and third tasting they will commence to like it, and then begin to demand it. The avocado is really something different in the fruit world. It has been described as "The Fruit Sensation of Modern Horticulture," and one of the greatest sources of food supply which the tropics have to offer. Up to the present only a few orchards have been planted in Queensland, and most of these are not yet in bearing. The limited supply of fruit now marketed is yielding exceptionally high prices to the growers. As production increases, the prices will come down, of course, when the public generally will have a better opportunity of becoming interested in the fruit, which in turn will naturally result in a bigger outlet.

The Mango.

The mango is a fruit which will grow in almost any part of Queensland. It grows freely from seed, but as the progeny very rarely, if ever, yield fruit of quality equal to the parent, the result is that many poor

varieties are now grown. Some enterprising orchardists of recent years have concentrated on the production of only the better types, and are able to export them successfully to the big cities of the South at good prices. There is room for a greater production of these choice varieties, which will soon oust the poorer sorts which at present dominate the market.

Dates.

It is interesting to note that 9,000,000 lb. of dates are imported into Australia each year. It has been demonstrated that in Western Queensland dates grow and ripen their fruit to perfection. The main requirement is plenty of water, and wherever bore water—which at present is flowing away in millions of gallons—is available, dates may be grown to excellent advantage.

SOME TROPICAL FRUITS.

No. 12.—THE COCHIN-GORAKA.

S. E. STEPHENS, Northern Instructor in Fruit Culture.

THIS fruit was introduced to North Queensland many years ago, and found conditions sufficiently congenial for its establishment without any great difficulty. It is a handsome tree of symmetrical appearance, and possesses value as a decorative foliage plant. As a fruit tree,



Plate 218.
Fruiting Habit of the Cochin-goraka.

however, it is not a great success, although it crops heavily under suitable conditions. It is known botanically as *Garcinia xanthochymus*, and is a native of Southern India and Malaya.



Plate 219.

The Cochin-goraka, *Garcinia xanthochymus*, approximately twenty years of age.

In North Queensland the tree thrives on various types of soil, but appears to give best results on low-lying alluvial soil which maintains a good moisture content but yet is well drained. On the deep red volcanic soils it also does well, but does not make quite as vigorous growth nor yet crop quite so heavily. This may probably be accounted for by the tendency of our volcanic soils to dry out owing to the low water table usually associated with them.

The tree is easily raised from the large fleshy seeds, which germinate most readily if sown in a bed of leaf mould kept well moistened and shaded. Root development is often somewhat sparse in the young plants, and growth for the first twelve months is rather slow.



Plate 220.

The Mangosteen, *Garcinia mangostana*, approximately twenty years old.

The growth of the head is naturally symmetrical, and very little pruning is necessary to form a shapely tree. The leaves are large—up to about fifteen inches long by four inches wide—glossy, dark green, and leathery, and of pendulous habit. They are produced decussately on four-angled branches. The branches radiate from the central main stem almost parallel to the ground. Fruit is borne in clusters, laterally on the larger and smaller branches. It is smooth-skinned, and when mature up to three inches in diameter. The shape is unusual, the body of the fruit being almost spherical, and the apex prolonged into a slightly depressed point, whilst the stem is set below the central point on the other end. The axis of the fruit is thus offset towards the lower

side. The ripe fruit is of a bright orange yellow colour, and presents an attractive contrast to the deep green foliage. In North Queensland the fruiting season is from July to Christmas.

On running a knife transversely round the fruit, the apex end may be lifted off, and the peculiar construction may then be noted. Beneath a tissue-like outer skin is a fleshy and juicy rind of the same yellow colour. Within this a number of segments or "quarters" are disposed in similar fashion to the segments of a mandarin. These are also yellow in colour—sometimes just a shade lighter than the skin. These constitute the edible portion of the fruit, and when thoroughly ripened are of a refreshingly acid flavour. Before the fruit attains the bright yellow colour, however, the flesh is obnoxiously acid, whilst the fleshy rind at this stage is very astringent. Some segments of the fruit will be noticed to be larger than the remainder, and will be found to contain one large fleshy seed each.

According to H. F. Macmillan, the Cochin-goraka is used for the manufacture of a yellow dye. Both the bark of the tree and the skin of the fruit exude a bright yellow, sticky substance when injured, and in Assam particularly this is used in dyeing cloth.

In Queensland this tree has been and still is confused by many people with the mangosteen, by which name it is frequently called here, any many people have planted it under the mistaken impression or false information that it was the mangosteen. However, although it can claim relationship with the mangosteen, it is no more entitled to that name than a pear would be to the name of apple, for although the apple and pear belong to the one family they are distinct species. And so it is with the mangosteen and Cochin-goraka. While there may be some difficulty in distinguishing the two in young seedlings, the differences become more marked in the course of a year or two. The foliage of the Cochin-goraka is of a pendulous habit, giving the tree a drooping appearance, whereas the mangosteen has upright growing foliage, giving that tree an erect appearance. A reference to the two accompanying plates will best illustrate this difference in appearance. The fruit, too, are vastly different, both in colour and shape, as may be seen by the illustration.

CLUSTER OR PART-HAND PACKING OF BANANAS.

JAS. S. GREGORY, Instructor in Fruit Packing.

FOR some years past packing in singles has been the general method adopted for sending cased bananas to Southern markets. This method of packing was encouraged by wholesalers and retailers because it was thought that more fruit would be contained in the case. The ripeners also found it more convenient when ripening, as it enabled them to remove individual fruits which might ripen before the remainder in the case. With full-hand packs this would have been difficult to do. Whilst bearing this in mind one cannot help believing that the extra quantity in the case was really the main factor in the preference for packing in singles. This should now no longer be a serious consideration, as experiments with the same fruit have shown that a well-packed case of clusters contains the same amount of fruit as when packed in singles. As an example, a test case packed in full hands

contained two dozen less bananas than when packed in clusters. The clusters were then broken and packed in singles, and it was found there was a difference in content of only two bananas in favour of packing in singles.

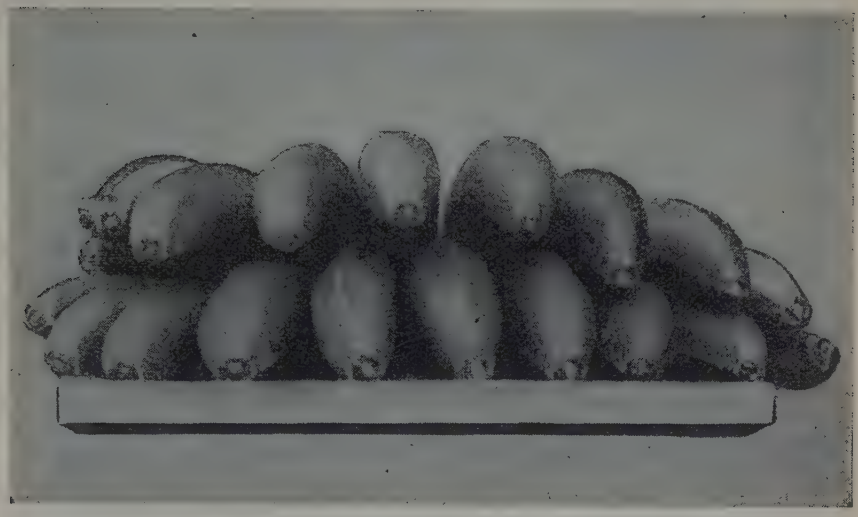


Plate 221.

A Hand of even Fruit which is very suitable for breaking into Clusters. See Plate 222 for Cluster Packing.

With the disposal of the argument with regard to shortage of fruit, the reasons in favour of the cluster pack by far outweigh those in favour of packing in singles. It must also be kept in mind when analysing the arguments for and against the various methods of packing that any extra work has to be done by the grower, and not



Plate 222.

The same Hand of Fruit as in Plate 221, showing how Fruit will fit together when pressure is applied.

by any others who handle the fruit after it leaves the plantation. The following arguments support the adoption of cluster packing:—

1. When packing in singles extra labour and time are required than when packing in clusters.



Plate 223.

An uneven Hand which would require breaking into smaller Clusters of three or four.

2. The risk of damage through bending the shanks of the bananas when breaking into singles is minimised. It is not necessary to break the shanks of any bananas, the small piece of the collar left on the hand after cutting from the stalk being the only thing that is broken.

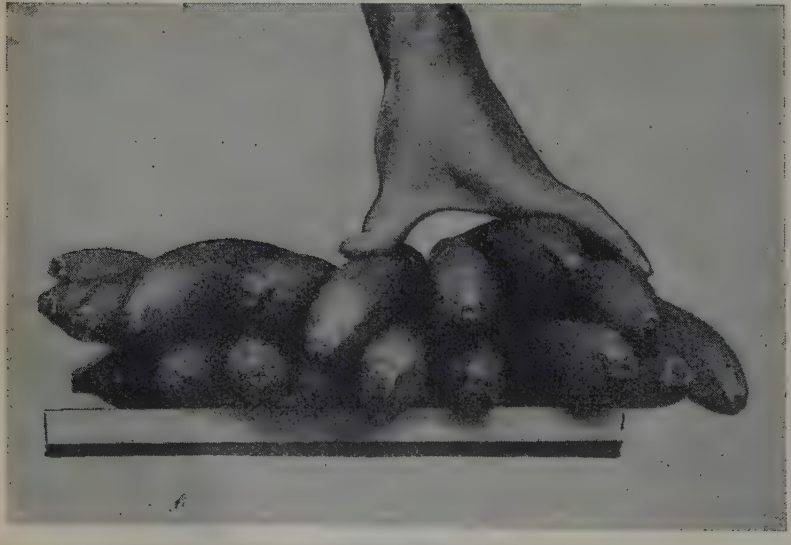


Plate 224.

The same Hand as Plate 223. Compare this Hand with Plate 222 to notice the difference in the way the Fruit fits when pressure is applied.

3. When packing in singles a high percentage of bananas that have been mutilated often happen to get placed in packed cases. This risk is almost completely obviated in cluster packing.

4. The early development of black-end, stem-end rot, and squirter because of stalk damage is prevented in the case of the cluster pack, thus enabling a much nicer-looking fruit to be retailed. Fruit badly affected with stalk collapse through black-end &c., does not sell as readily as fruit with solid stalks, top prices being much harder to obtain.

5. Single bananas do not ripen up with so fresh an appearance as bananas in clusters or hands, often having a wilted appearance. When retailers have to purchase fruit showing specimens with stem-end collapse or wilted in appearance, they naturally pay a lower price. This has a tendency to lower the trend of market prices.

6. As the clusters when packed are "pegged" or tightened by using twos or singles, no more difficulty should be experienced in packing all normal bunches of fruit in clusters than in singles, as awkward hands can be used for pegging.

Packing the Cluster or Part-hand Pack.

As the name shows, clusters comprise parts of the hand of bananas. These "clusters" contain three, four, five, or six bananas, depending upon the type of fruit available. A hand that contains an even type of fruit (Plate 221) can easily be broken into clusters containing up to six bananas which will fit together firmly (Plate 222). Plate 223 illustrates an uneven type of hand which would need to be broken into smaller clusters of three or four before they would fit snugly together without damage when pressure is applied. An examination of Plate 224 will point out the difficulties with hands of this description. It can be seen from these illustrations that it would not be altogether practicable to lay down a fixed number for each cluster. A packer must use discretion to obtain the best results, practice soon making perfect. Spaces between the clusters can be filled by using singles and twos to obtain a tight pack. Singles can also be used as key bananas for the centres. Packers should make it their aim to keep the clusters as large as possible, as this shortens the time taken for packing and also decreases the chances of black-end and squirter development.

Types of Cluster Packing.

As with single packs, there are different methods of placing the fruit. The clusters can be placed vertically with the concave side down (Plate 225) or placed on their sides (Plate 226). The vertical pack is recommended in preference to the side pack. The fruit fits together better with less chance of damage whilst in transit, although it must be observed that the heels of the fruit do not get case-marked as easily as when the concave pack is used. A better weight of fruit is placed in the case with the concave cluster pack. To do the side pack successfully greater care has to be exercised in the selection of suitable clusters.

Method of Starting Vertical Cluster Pack.

A layer of clusters of twos or fours is placed on their sides upon the bottom of the case in the same manner as the bottom row in the start of single packing (Plates 227 and 228). Both the straight and "S" types of bottom layer can be used to suit different types of fruit.

The next layers of clusters are then placed upon this fruit, concave side down. The case is finished by repeating the second layer until full.

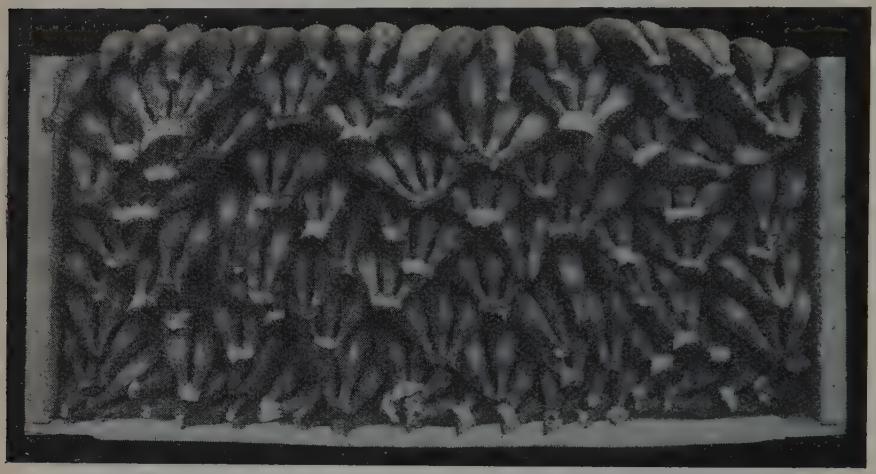


Plate 225.
Complete Part-hand Pack placed vertically; opened at side.

Where the straight type of pack is used in the first layer for starting the case, it is recommended to start one of the sides of the layer with a two and the other with a cluster of four. This will assist in overcoming the difficulty encountered through the top and bottom lines of fruit in each hand being of different lengths. By starting with a two the shorter bananas on the clusters placed on one side of the box are brought opposite the long bananas on the clusters on the other side. With the "S" type of first layer this automatically takes place when the clusters are turned.

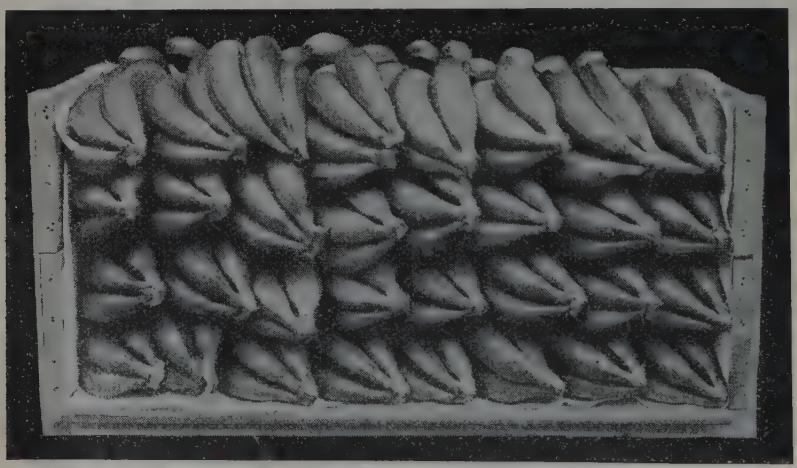


Plate 226.
Clusters placed on their side. This pack looks nice, but does not contain the weight of fruit. Clusters mainly all four bananas, and rowed in well. No case making on heels of fruit.

[*Photo. by courtesy New South Wales Department of Agriculture and Stock.*

A tighter pack is obtained if the clusters of a layer are placed on the spaces between the clusters of the layer beneath (Plate 225). Care must be taken to finish one layer before starting the next. Any spaces caused through the unevenness of the clusters should be filled by using singles or twos. Uneven clusters should be broken up into singles and twos for this purpose. Six-inch to 9-inch fruit can be packed in this manner.

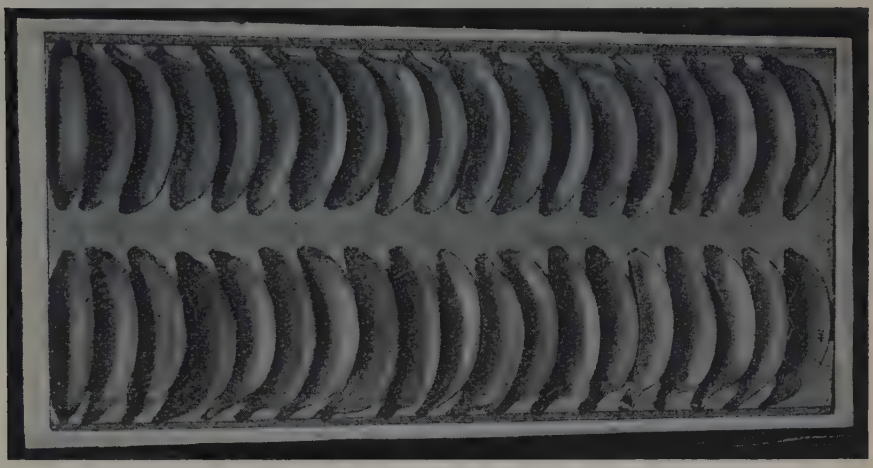


Plate 227.
Method of placing First Layer of "Sixes," "Sevens," and small "Eights."

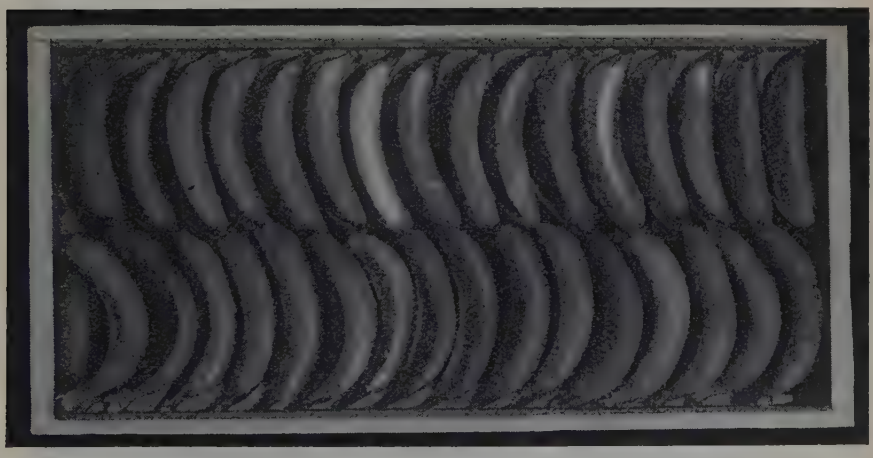


Plate 228.
Method of placing First Layer of Curved "Eights."

Side or Flat Packing.

To start this pack a full cluster of four is used, the bottom layer fruit being placed on its side. The case is finished by repeating this layer by layer until the case is finished (Plate 226). The shortcomings of this pack have already been pointed out. Six-inch to 9-inch fruit can be packed in this manner.

Plate 230.
Large, Long Fruit Type.

Plate 229.
Large 10½-inch Bananas.



Plate 231.
Packing Long Fruit. Case with Top Removed.

Cluster Packs for Straight and Oversized Fruit.

Large long and straight long fruit (Plates 229 and 230) present difficulties in packing which the two packs mentioned do not easily overcome. Experiment proved that the easiest method was to pack the long clusters lengthwise in the case and fill in the middle (Plates 231 and 232). Use, as far as possible, the better-shaped curved fruit for the centre, keeping the straight for the two ends. Fruit of this type constitutes only a small percentage of the banana output during January and February, and no grower should experience much trouble in overcoming the difficulties encountered.



Plate 232.
Packing Long Fruit. Case with Side Removed.

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit Packing.

THE prolonged spell of dry weather is causing much worry to growers Much small citrus fruit has still to be disposed of, especially as the Valencia Lates this season have generally been on the small side. As the trees are at present carrying fruit as well as being in bloom, the indications are that the prolonged dry spell will mean either a normal setting with small fruit or a light setting.

The problem of small oranges has still to be overcome and greater efforts should be made to increase their use for juice, &c. The larger sizes are easy to sell to the retail trade, the grower's chief difficulty being to dispose of the small fruit. Unfortunately this does not apply only with citrus fruits, as all fruits suffer the disadvantage of lack of means for the disposal of small fruit.

The markets generally have retained values, with the exception of bananas, which on the interstate markets have declined considerably in price.

Prices on the various markets during the last week of September were as follows:—

Papaws.

In Brisbane local fruit brought 2s. to 3s per bushel case, Gunalda fruit 3s. to 4s 6d. per bushel case, and Yarwun 5s. 6d. to 7s. per tropical case. Melbourne prices were from 7s. to 10s. per tropical case, and Sydney from 6s. to 11s.

Poorly coloured lines were hard to sell. From now on when sending to Southern markets growers should select fruit with a little less colour than was their practice during the winter months.

Granadillas.

The season for this fruit appears to have finished. The writer experimented with fruit sent from Cairns, and succeeded in keeping it for three weeks when it ripened in perfect condition. A description of the methods adopted will be published at a later date.

Custard Apples and Avocados.

These two fruits are now practically off the market. Fair quality Custards sold well at from 4s. 6d. to 5s. per case.

Mangoes.

The first consignments from Townsville have appeared on the Brisbane market and sold at 10s. per bushel case. Suppliers sending to Brisbane would do well to wrap their fruit. The impression was gained from some consignments that the fruit had been hammered from the trees with a stick, and growers should note that such careless methods of handling will do much to spoil a good market for far-Northern mangoes.

Pineapples.

The factories have been operating freely during the month, and have thus assisted to maintain values on a sound level.

Brisbane prices for smoothleafs ranged from 3s. to 6s. 6d. per case, and 2s. to 6s. 6d. per dozen loose. Ripleys returned 6s. to 9s. a case, and 2s. to 5s. 6d. a dozen. Melbourne prices ranged from 8s. to 10s. per case, and Sydney prices from 7s. to 9s. Green lines are not wanted.

Bananas.

The writer has inspected many bunches of bagged fruit. The practice of bagging bunches on the plant, even apart from any other reasons for its adoption, is well worth while, merely for the way in which the fruit at the back of the bunch is brought up to size, instead of the front of the bunch filling while the back fruit remains thin and angled.

In Brisbane Cavendish bananas realised the following prices—Sixes, 8s. 6d. to 12s. per case; Sevens, 9s. to 13s.; Eights and Nines, 10s. 6d. to 14s 6d. Lady's Fingers at 3½d. to 7d. a dozen, and Sugars at 4d. to 5¾d., were rather slow of sale.

Melbourne prices for Cavendish were—Sixes, 12s. to 13s.; Sevens, 14s. to 15s.; Eights and Nines, 16s. to 17s.; a few special lines higher.

Sydney prices: Sixes, 14s. to 16s.; Sevens, 16s. to 18s.; Eights and Nines, 18s. to 21s.

Passion Fruit.

There was an excellent demand for this fruit, Brisbane prices ranging from 5s. to 12s. per half-bushel case, Sydney prices from 6s. to 12s., and Melbourne from 12s. to 14s., with special lines higher.

Strawberries.

The season is now nearing its finish, and supplies are lighter. In Brisbane 5s. to 9s. a dozen boxes were obtained, and 10s. to 13s. for choice lines; in Sydney trays brought from 4s. to 7s. each, and boxes from 6s. to 17s. a dozen.

Citrus Fruits.

Oranges and mandarins of good quality are selling well, but small sizes below 2½ inches are not popular and are hard to shift.

Brisbane prices: Oranges, choice 5s. to 7s., small 3s. to 4s.; Gayndah 7s. to 8s., Redland Bay 4s. to 7s., Benyenda 7s. 6d. to 8s. 6d., New South Wales Navels, 6s. to 8s. 6d. per case. Mandarins, of which the general quality is rapidly falling off, King of Siam 5s. to 7s., Waratah 8s. to 11s., and Glens to 10s., if in good condition. Lemons, 3s. to 5s. ,with Gayndah and Benyenda from 8s. to 12s.

Sydney prices: Oranges, Navels, 4s. to 7s., Joppa 4s. to 5s., Valencia 4s. to 6s. Mandarins, local Emperors, 3s. to 10s.

Melbourne prices: Oranges, Navels 4s. to 11s., Commons, 4s. to 8s. Mandarins, 5s. to 10s. Grapefruit, 4s. to 10s. Lemons, 4s. to 6s.

Tomatoes.

The prolonged dry spell has brought on a shortage of supplies, and consequently prices are higher. In Brisbane local ripe fruit realised 3s. to 8s., green 4s. to 8s., and coloured to 9s. for good quality. In Sydney local fruit brought 10s. to 13s., and Queensland fruit 10s. to 12s. In Melbourne 13s. to 14s. was obtained for Adelaide hothouse fruit, and 7s. to 10s. for West Australian fruit.

Apples.

Apples are selling well in Brisbane, supplies of Queensland apples now being finished. Victorian Jonathans ($2\frac{1}{2}$ and $2\frac{3}{4}$ inch) brought 12s. to 13s., and Rome Beauty 8s. to 11s. Tasmanian Sturmers realised 8s. to 11s., and French Crab 9s. to 13s. New South Wales Kentucky Granny Smiths sold at 14s. 6d. to 15s. 6d.

Cucumbers.

Prices in Brisbane were 6s. to 9s., Sydney 10s. to 12s., and Melbourne 6s. to 9s.

Lettuce.

Lettuce on the Brisbane market realised from 6d. to 1s. 3d. per dozen.

Beans.

Brisbane prices were from 6s. to 11s. per sugar-bag, and Sydney prices from 2s. to 9s. per bushel case.

Assistance and advice in the packing and marketing of all fruit will be gladly furnished upon application to the Under Secretary, Department of Agriculture and Stock, William Street, Brisbane, B.7.

BRANDING CATTLE—A QUICK HITCH.

Here is the handiest method of securing cattle for branding. Speaking as one who has had quite a lot of experience in this work in the east and west of the continent, I think that the method here advocated has many advantages. I have done large numbers of stock with only one helper, and where big mobs are being handled and more hands are available, the method can be used at several parts of the yard simultaneously.

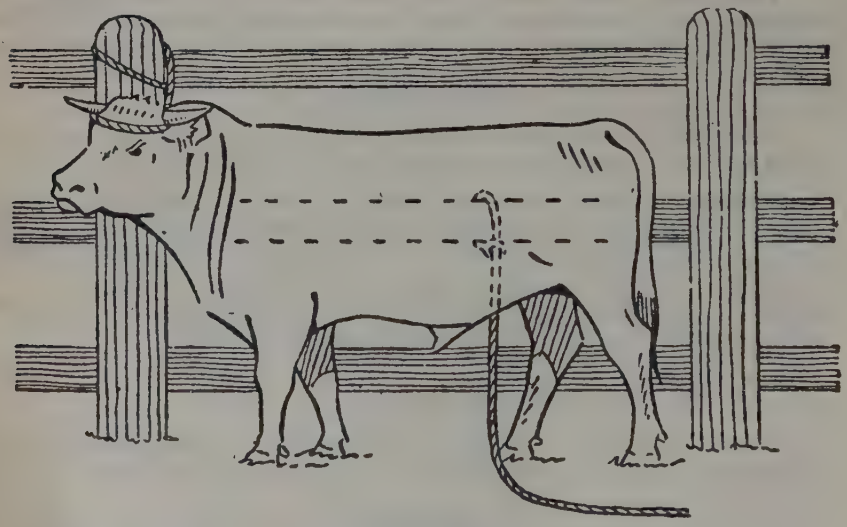
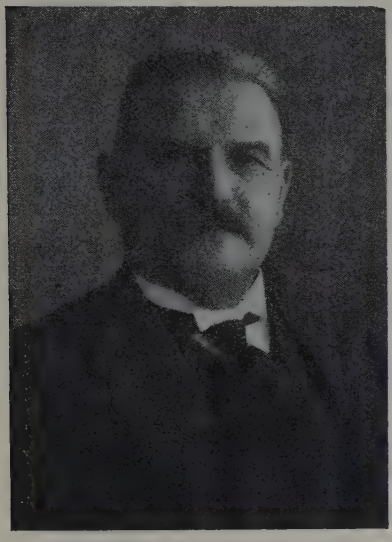


Plate 233.

The beast is roped over the horns or neck and pulled up to the rails of the fence. Another rope is tied to the fence at about the height of the beast's hip and allowed to lie on the ground, and as the beast is brought up to the fence the rope is thrown over the top rail and hauled tight. I know of many fittings which can be added to stockyards to simplify branding, but this is the simplest as it can be used in any stockyard and only the two ropes are necessary.—A correspondent in the "Western Mail." (W.A.).

The Passing of a Great Veterinary Scientist.

THE recent death of Sir Arnold Theiler in London marked the passing of a great scientist and a world-famous veterinarian. This great South African was well known in Australia, having spent six months here in 1928 in an advisory capacity to the Commonwealth Government. In the course of that time he visited Queensland, and the stockowners of this State benefited largely from the advice he was able to give on many of our important veterinary problems. In South Africa in his long career he had achieved a triumph in veterinary science and had been an inspiration to veterinarians the world over.



The Late Sir Arnold Theiler.

In "The Veterinary Record"* for August a very moving tribute is paid to his memory, and from which the following abridged account of a great career is taken:

The reputation of Sir Arnold Theiler was made in South Africa, and from the date of his entry into the Transvaal as veterinary pioneer in 1891 his life was an arduous but triumphant struggle against the many diseases which had thwarted the agricultural development of that country since the days of the Great Trek.

To few men is it given to see in their own lifetime so much of the practical economic results of their researches, and to receive such world-wide recognition before their death. As Sir John Russell expressed it in his address on "The Changing Outlook in Agriculture" at the Centenary Meeting of the British Association in 1931: "It is difficult to overrate the value of the service he has rendered to South Africa as a country and to farm animals the world over. He began at the time of the rinderpest plague in 1895, a virus disease which killed almost the entire cattle population of South Africa; the country was devastated by horse sickness, blue tongue of sheep, heartwater of cattle, sheep, and goats, and other terrible diseases. With almost uncanny precision he diagnosed the causes of these diseases and discovered curative measures; he founded the Veterinary Research Laboratories at Onderstepoort, of which not only South Africa but the whole Empire is proud, and he trained up a body of veterinary research workers who are extending the good work."

Theiler was honoured in every country in the world. He received seven honorary degrees from universities in three continents, the highest honours from scientific societies, a C.M.G. from Edward VII.,

* Official Journal of the National Veterinary Medical Association of Great Britain and Ireland.

a knighthood from George V., and a royal decoration from Belgium. He was the first recipient of the Gold Medal and Grant of the South African Association for the Advancement of Science and of the Captain Scott Memorial Medal from the South African Biological Society, the first recipient of the Laveran Medal from France, the second recipient of the Budapest Prize from the International Veterinary Congress and of the Medal of the Royal Agricultural Society of England. Amongst his earlier honours was election as Associate of the Royal College of Veterinary Surgeons of Great Britain and Ireland in 1907; amongst the latest was his election to the French Academy of Sciences in 1933, and to the Fellowship of the Royal Society of Medicine in 1934. His honorary degrees included the D.Sc. of the Universities of South Africa, of the Cape of Good Hope, and of Johannesburg, the D.V.Sc. of South Africa, Dr. Phil. of Berne, Sc.D. of Syracuse, U.S.A., and the D.Sc. of the University of Utrecht.

Born on 26th March, 1867, at Frick in the Swiss canton of Aargau, he was the son of a schoolmaster and received his early education at the hands of his father and at the gymnasium of Aargau before proceeding to the study of veterinary science at the Universities of Zürich and Berne.

In South Africa his inborn genius for investigation and his untiring energy now found their natural outlet and it was not long before his published work was attracting attention throughout the whole world. His ability to apply scientific research to the solution of problems of pressing economic importance and produce practical results of immediate benefit to the live stock industry, rapidly gained the confidence of the administration—above all, the confidence of the farming community.

Theiler was a man free from financial timidity in experimental work. He vindicated scientific research as a straight business proposition and pressed for increasing grants as fast as he produced results.

His own early research work was mainly in bacteriology, protozoology, and virus diseases—the name *Theileria* for a genus of intracellular protozoan parasites, commemorates this phase of his career, *Theileria* parva being the casual species of East fever. His work on the tick transmission of the piroplasmoses became classical. His early method of immunisation against horse sickness, more efficient with the mule than with the horse itself, rendered transport possible in areas formerly fatal to equines. His production of a vaccine for "blue tongue," a fatal catarrhal fever of sheep, stimulated the wool industry of the country. His net, however, was flung so wide that it would take a monograph on Theilerian research to do justice even to his "first reputation"—the reputation for which he was knighted in 1914.

It is given to few men to build four almost distinct reputations; Theiler did this and some scientists who recognised his eminence in their own field may hardly have heard of his reputation in the others.

Of economically important work done by Arnold Theiler may be mentioned the control of haemonchosis in sheep, research into diseases caused by poisonous plants, improvements in vaccine production and in immunisation against horse sickness, but above all the elucidation of the cause of "Lamsiekte" in 1917, a cattle disease which threatened

South African farmers with ruin over vast tracts of the country. Out of this last work sprang the long series of researches on aphosphorosis of ruminants and diseases associated with mineral deficiency—work which continues to this day and which provided Theiler with material for the histological studies into the skeletal diseases of the domesticated animals, to which he devoted the years of his retirement.

Some of the younger staff of his pioneer days may have felt roughly handled by the driving force of their tireless chief, and were certainly worked to the limit of their capacity by a man who made his own first round of inspection of his institute at 6.30 in the morning, observed all his experimental animals before breakfast, gathered his professional staff together at 8.30 a.m. with the blast of a siren from the clock tower, and brought them into conference every Wednesday night to discuss the scientific literature they had been reading during the week. But he lived to see them all grateful for his paternal discipline and few men have been more honoured by their disciples in their later years.

From 1921 onwards he occupied the positions of Dean of the Veterinary Faculty and Professor of Tropical Diseases in the University, in addition to his Directorship of Veterinary Research under the South African Department of Agriculture, until his retirement in 1927.

It was characteristic of the man that when he relinquished control of the largest institute in the world specially devoted to veterinary science, and of 100 white workers of whom about thirty were professional graduates, he at once cast about for an individual line of private research to occupy his retiring years—a line with which his own two hands could cope despite the handicap that one of these was wooden from the wrist.

In public life Sir Arnold Theiler was a compelling personality and great driving force. In private life he was modest, humorous and kindly, of simple habits and tastes, and revealed to his intimate friends the man of deep sentiment behind the man of action. He had faith in his star of destiny but was entirely free from lesser vanities. His ability as a leader arose from his enthusiasm for the "thing in itself," and his capacity for inspiring enthusiasm in receptive minds. As a director he was a rigorous disciplinarian and demanded unswerving loyalty from subordinates, but he strongly supported all who gave him service. He was a born teacher and although intolerant of indolence he showed infinite patience with the "man who tried his best."

The high standing of the veterinary profession in South Africa, and adequate financial recognition in Government service, is largely the result of his efforts, but his influence on the status of veterinary science is wider than that—he has done much to convince the administrative mind all the world over, that expenditure on veterinary research is a profitable investment for any country.

Genius has been defined by one sage as "intuition which has the warrant of ultimate certainty," and by another as "infinite capacity for taking pains." Theiler fitted both definitions. Few man have displayed more doggedness in arriving at the truth by patient elimination of possible hypotheses, but periodic flashes of insight has often provided the clue to his baffling problems.

The 1936 Brisbane Exhibition.

Departmental Displays.

Entomology and Plant Pathology.

A SERIES of island stands in the court of the Department of Agriculture and Stock provided a display of wide interest in respect of pest and disease incidence. The varied nature of the research activities of the Division of Entomology and Plant Pathology was evidenced by material showing the characteristic symptoms of injury by insects, fungi and bacteria to tomatoes, tobacco, bananas, papaw,

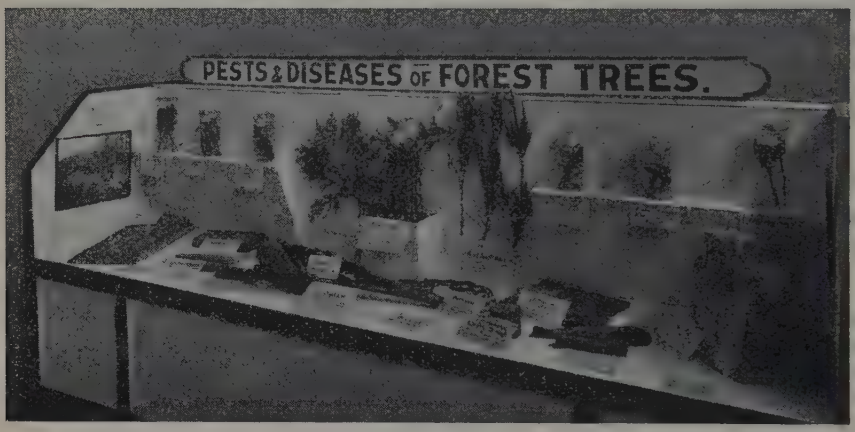


Plate 234.

passion fruit, citrus, vegetables, cereals, forest trees and timber, the several organisms being the subject of investigational work. Preserved specimens were included in the display, supplemented to a large extent by living plant material on which the blemises, malformations and decay were clearly recognisable, and also by cultures indicating the method of handling the organisms in the laboratory. Similarly, insect

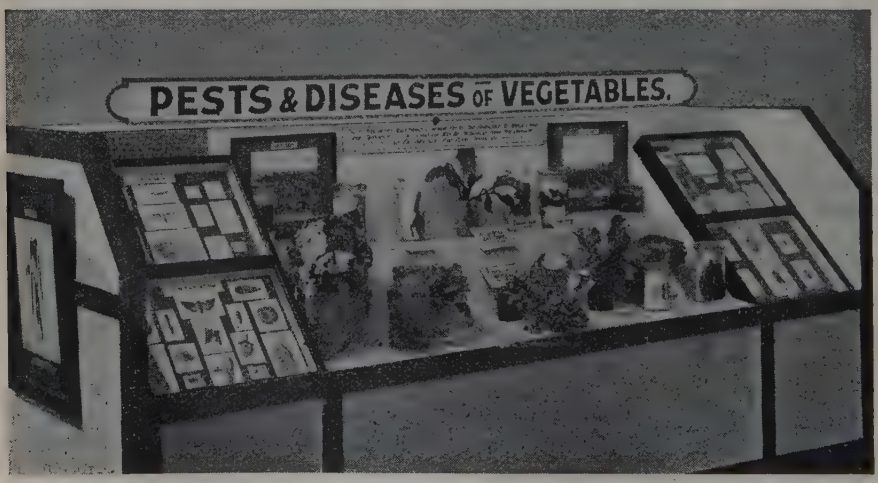


Plate 235.

specimens and detailed enlargements enabled those most interested—the primary producers—to familiarise themselves with the appearance of the more important pests.

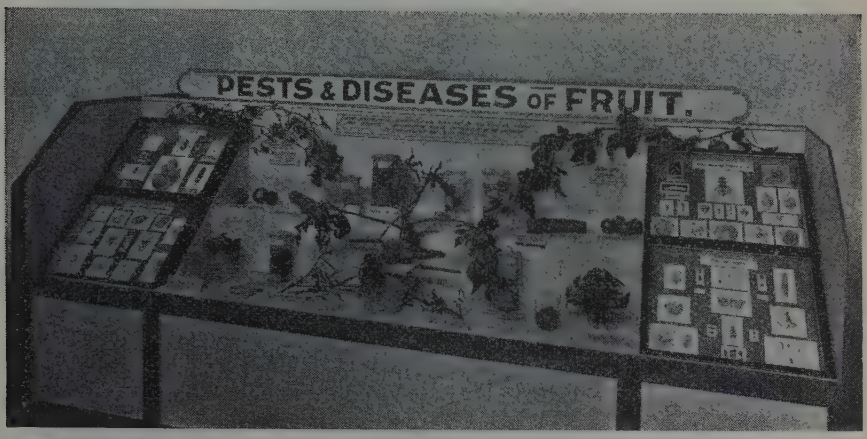


Plate 236.

Ability to recognise an insect pest in each of its transformation stages, or the symptoms of a fungal or bacterial trouble in the early stages of attack are matters of first importance to the grower. The application of an appropriate remedy, or the eradication of a dangerous breeding centre can then be carried out sufficiently early to minimise the extent of injury. For this reason primary producers were repaid amply for any time they spent in viewing this exhibit.

An important addition was a display of insectivorous birds, accompanied by specimen cases, demonstrating the value of most of our Queensland birds as allies in the destruction of insect pests. Country and city dwellers alike can accomplish much by discouraging the indiscriminate and thoughtless destruction of valuable birds, and the display provided a lesson that should stimulate the public conscience in this important matter.

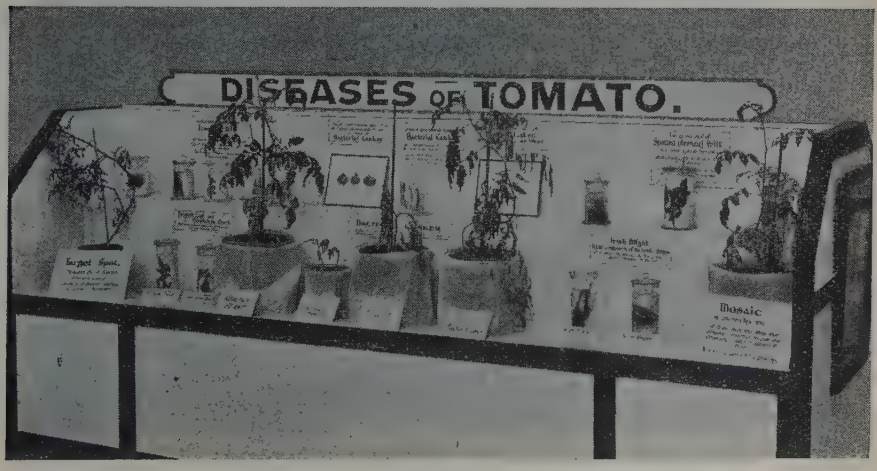


Plate 237.

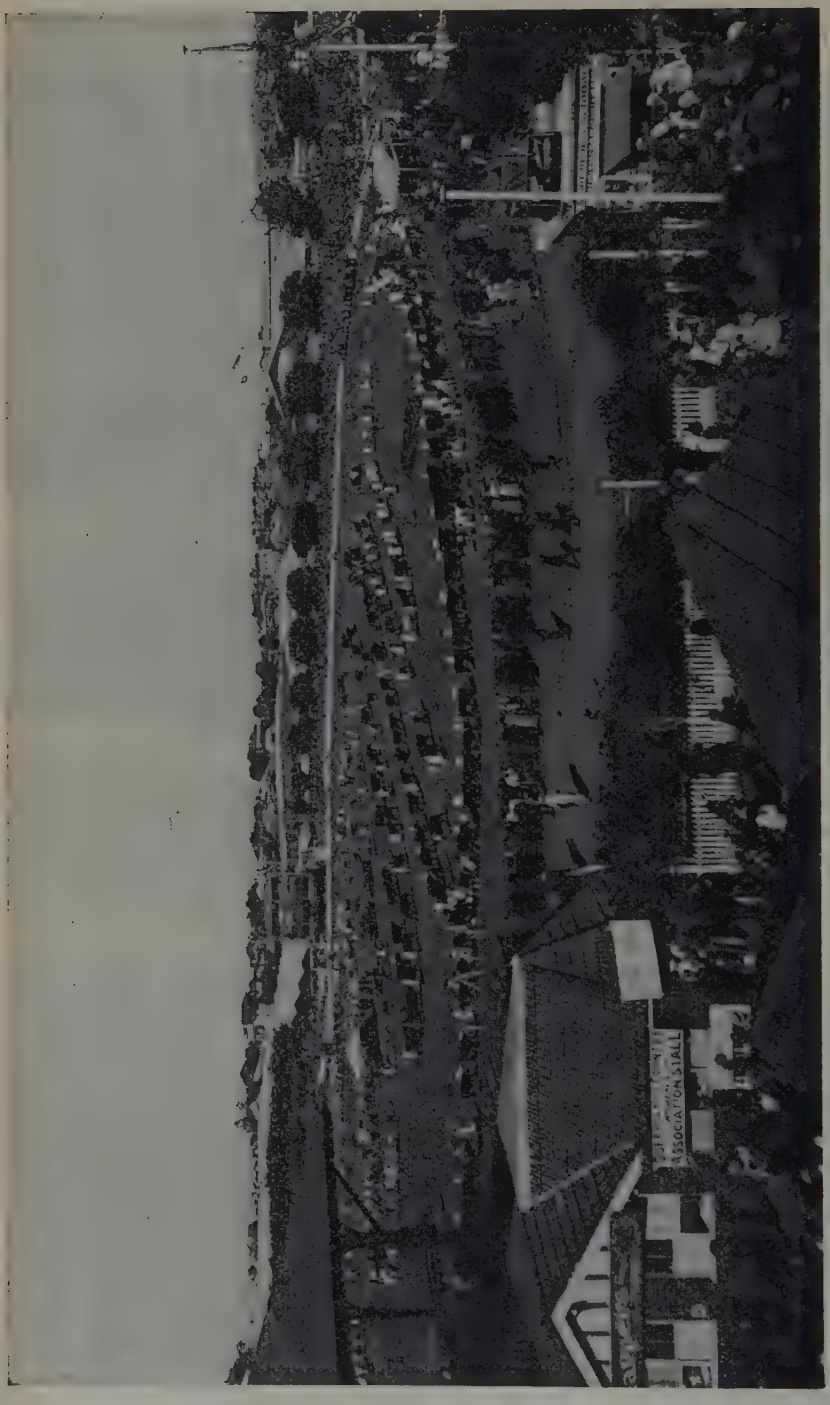


Plate 238.

1936 Brisbane Exhibition.—The Grand Parade of Beef and Dairy Cattle.



Plate 239.

The central trophy in the Agricultural Court illustrated the "cereal story" of the development of grain growing in Queensland. Wheat in sheaf and grain and corn in cob made a most effective display. The breeding and selection work carried out over a series of years has given excellent results, and the farmer has now a wide choice of high quality varieties. The cultural side was also featured, as the advantage of improved varieties is nullified unless sound methods of farming are regularly practised.

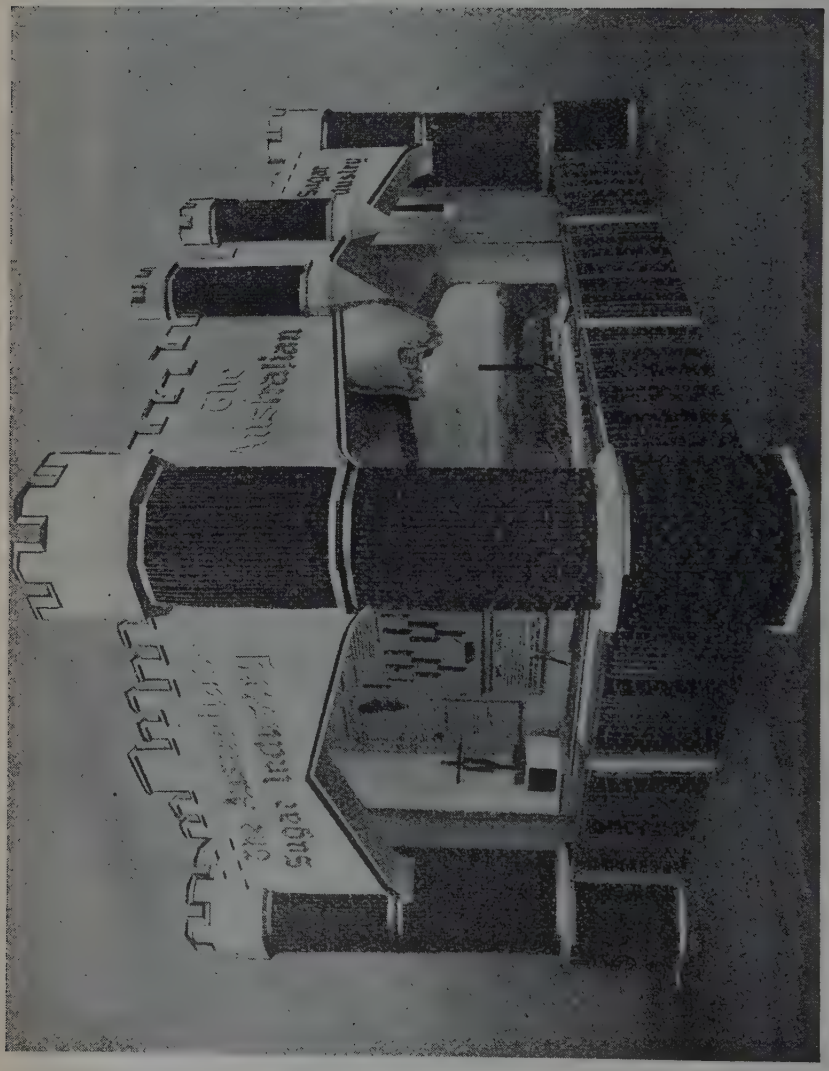


Plate 240.

Every phase of the sugar industry was represented in this impressive trophy.



Plate 241.

This working model of a Queensland sugar mill with a background of typical Far North coastal scenery attracted great public interest at the Brisbane Show.

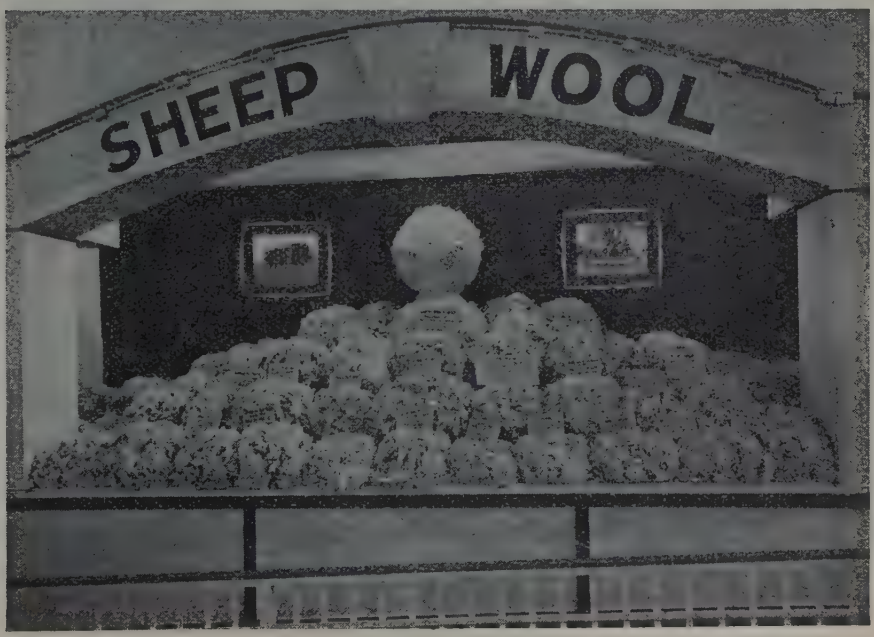


Plate 242.

An excellent show of fine Merino wools up to 90s.



Plate 243.

This bay in the Court of the Department of Agriculture and Stock contained excellent specimens of temperate and tropical fruits grown commercially in Queensland. Grading mechanism and a model of a "flying fox," illustrating the method of transporting bananas in hilly country, were among the principal features of a very fine exhibit.



Plate 244.
Cotton facts and concrete evidence of the wealth of Queensland's cotton lands.



Plate 245.

In this exhibit leaf from the Mareeba, Dimbulah, Townsville, Bowen, Mackay, Miriam Vale, and Texas districts was shown, and was graded to show the typical quality, colour, and size of leaf. Of the varieties in cultivation, Hickory Pryor, Yellow Pryor, Cash, Warne, and Gold Leaf are the most popular at present, while leaf of Bonanza, Jamaica, Conqueror, Gold Dollar, and Yellow Orinoco was also on view.



Plate 246.

The importance of seed maize selection was illustrated by the cobs and grain of the four chief varieties featured in this exhibit—Improved Yellow Dent, Reid's Yellow Dent, Funk's 90-Day, and Star Leaming.

Seed maize selection is an important activity of the Department, and its popularity is indicated by the fact that the demand for selected seed invariably exceeds the supply. A high standard has been reached, and efforts are directed continuously towards its maintenance and improvement.

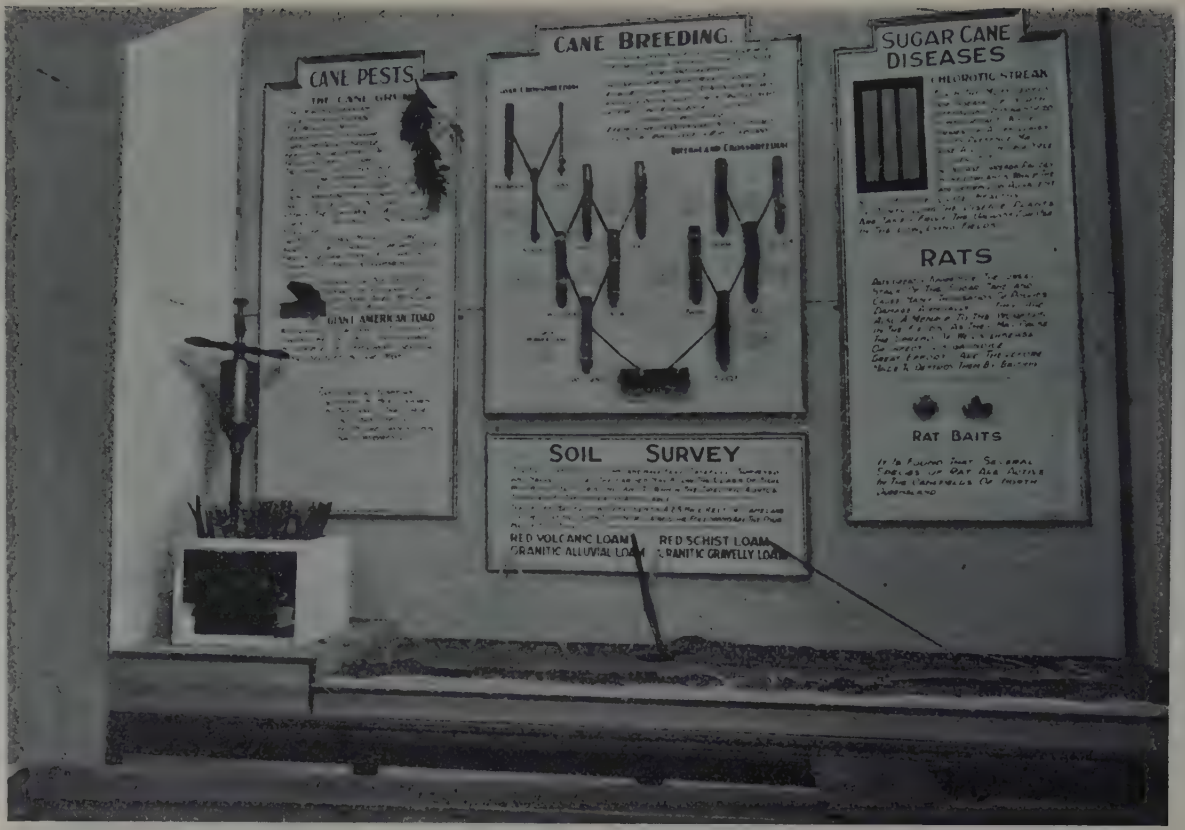


Plate 247.

This informative panel of the sugar exhibit illustrated the extent and value of the work of the Bureau of Sugar Experiment Stations.



Plate 248.
Outstanding sugar-cane exhibits.



Plate 249.

Sorghums.—This year a section of the Departmental Court was devoted to sorghums, both grain and feed types. At present, a considerable area is sown to the sweet or feed types, which are valued as fodder and silage—suitable varieties being Saccaline, White African, and Imphee. The grain types are not grown to a similar extent, but in view of their ability to yield heavy crops of nutritious grain under climatic conditions which would be fatal to successful maize production, it is considered that a large area could be devoted to their cultivation. An alternative feed grain produced economically would be welcomed by the pig and poultry industries.

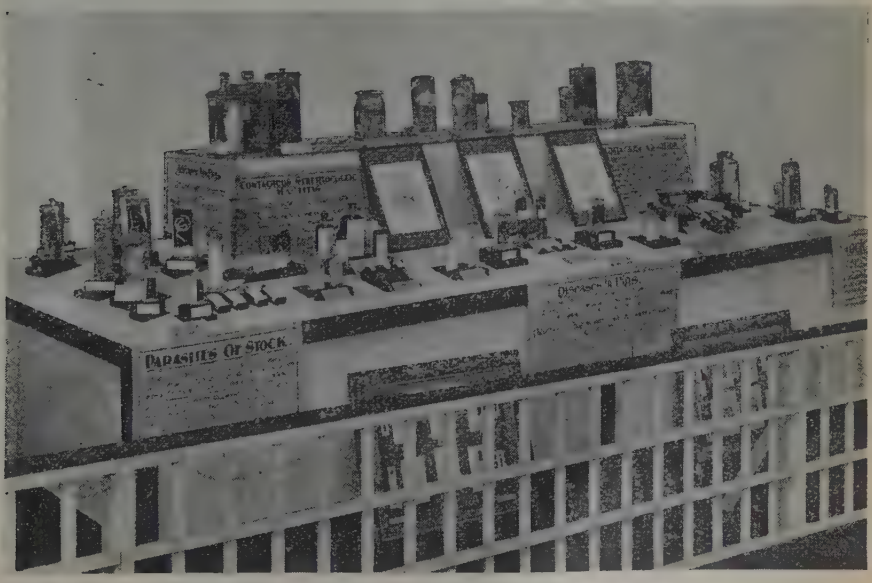


Plate 250.

Some branches of the work of the Animal Health Station at Yeerongpilly were illustrated impressively and effectively by this exhibit.



Plate 251.

AN ARRAY OF GRASSES AND EDIBLE SHRUBS ILLUSTRATED THE IMPORTANCE OF PASTURE IMPROVEMENT.—This year's exhibit comprised sheaves of the more important native grasses from which the pastoral wealth of the State is derived. Living specimens of summer grasses, winter grasses, legumes, and pasture weeds, were also shown, together with a sample of artificially-dried grass.

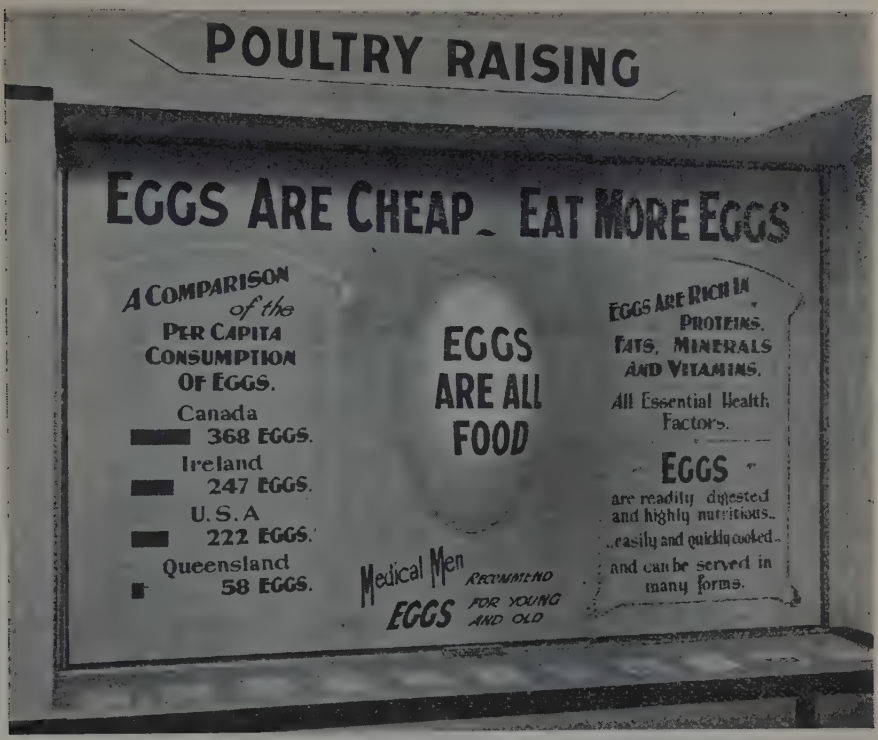


Plate 252.
A striking panel in the Departmental Court.



Plate 253.
The "Journal" Corner in the Departmental Court was a rendevous for farmers from the agricultural districts of the State, both far and near. Mr. Arthur F. Crees, of the Agricultural Branch, is the young officer in charge. Other officers associated with the several divisions of the Department of Agriculture and Stock were in attendance to advise show visitors on matters connected with the exhibits and the laboratory and field work of the Department generally.

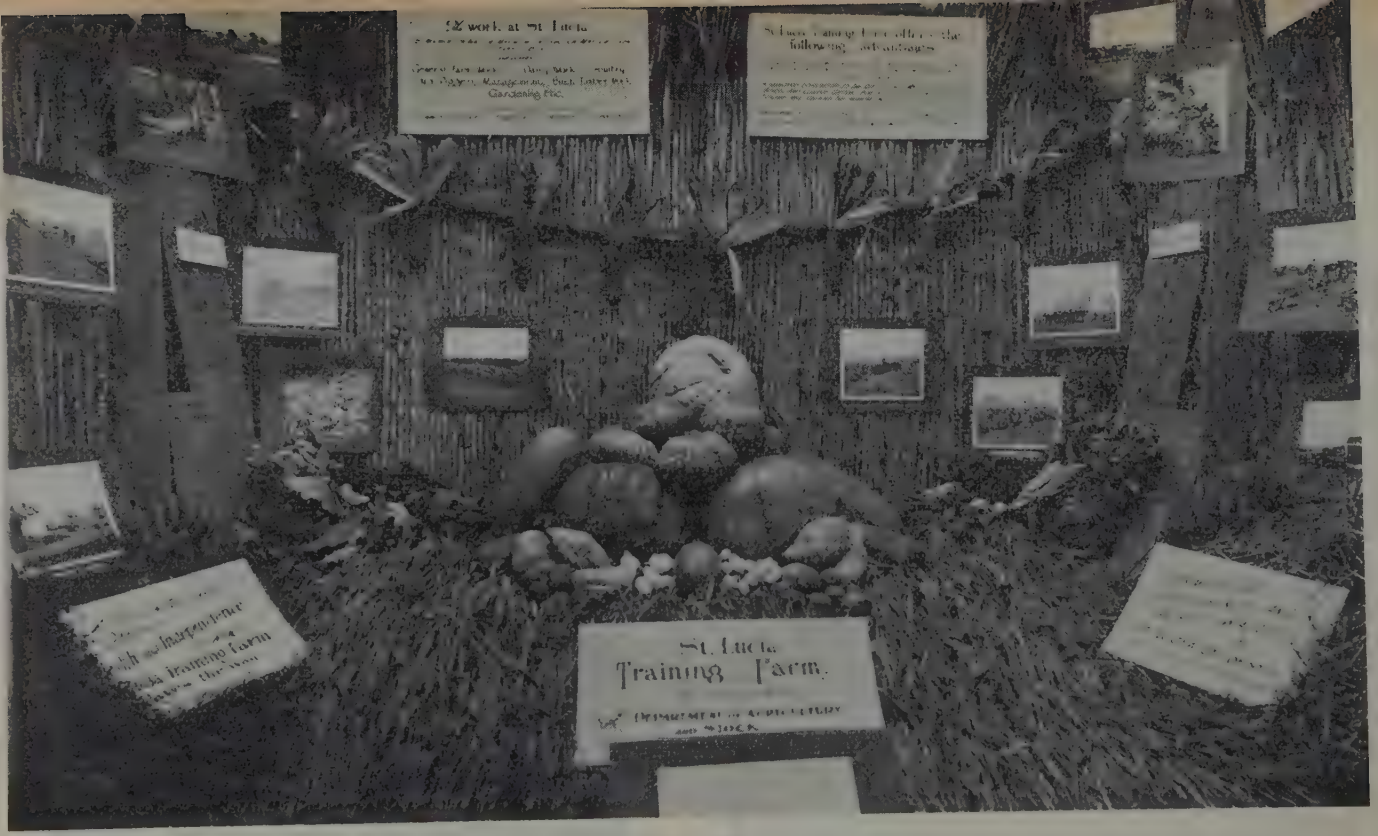


Plate 254.

ST. LUCIA FARM TRAINING SCHOOL FOR BOYS PROVIDED AN EXCELLENT EXHIBIT OF FARM AND GARDEN CROPS.—A free six months' practical farming course for youths and young men is available at St. Lucia. A thorough grounding in the rudiments of every branch of farm work is given amid beautiful rural surroundings on fertile land fronting a reach of the Brisbane River. At the end of the course a farm job for every trainee is guaranteed. Farmers' demand for St. Lucia trainees is far in excess of the number of boys available. This fact is a further demonstration of the practical value of the training that St. Lucia Farm Training School provides.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advance Register of the Herd Books of the Australian Illawarra Shorthorn Society and the Jersey Cattle Society, production charts for which were compiled during the month of August, 1936 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORN.				
SENIOR, 4 YEARS (OVER 4½ YEARS), STANDARD 330 LB.				
Cedar Grove Shannon 13th	Con. O'Sullivan, Ascot, *via* Greenmount	8536·5	359·22	Duke of Cedar Grove
Homelea Empress 2nd	J. Savage, Gleneden, Humphrey	9,195·33	345·014	Wonga's Commodore of Springdale
JUNIOR, 4 YEARS (UNDER 4½ YEARS), STANDARD 310 LB.				
Empress 32nd of Sunnyside	P. Moore, Wooroolin	8,592·55	361·378	Bruce of Avonel
SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD 250 LB.				
Headlands Ruby 5th	E. Althouse, Cloyna	7,266·45	295·889	Kalunga Bruce
H. V. Princess	R. Radel, Coalstoun Lakes	7,171·97	275·786	Burradale Emperor
JUNIOR, 2 YEARS(UNDER 2½ YEARS), STANDARD 230 LB.				
Headlands Rena	E. O. Althouse, Cloyna	7,267·75	256·721	Headlands Red Robin
Headlands Amy 10th	E. O. Althouse, Cloyna	6,356·15	250·977	The Valley Security
Rhodesview Queenie 18th (270 days)	W. Gierke and Sons, Rhodesview, Helidon	5,593·57	247·925	Rhodesview Red Knight
Rhodesview Backer 8th	W. Gierke and Sons, Helidon	6,449·12	247·265	Rhodesview Red Knight
Narvillus Maisie	Con. O'Sullivan, Ascot, *via* Greenmount	5,717·00	240·368	Parkview Mars
JERSEY.				
JUNIOR, 3 YEARS (UNDER 3½ YEARS), STANDARD 270 LB.				
Kensington Butter Queen	Miss. J. Nolan, Lindum	6,717·81	341·566	Banyull Lord Tiddlewinks
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD 230 LB.				
Dawn Governess	A. L. Walker, Dawn	5,842·2	312·441	Retford Glory's Victor
Elspeth of Calton	A. Geritz, Goomeri	5,623·3	299·314	Retford Glory King II.
Dione of Calton	A. Geritz, Goomeri	5,046·00	292·896	Retford Meteor
Ashview Maureen	C. Huey, Sabine	4,681·4	259·154	Pamela's Armlet of Woodbine
Queen Rose of Romsey	J. Wilkin, junr., Raceview	4,182·68	234·152	Retford May's Victor

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Notes on Grasses.

W.S. (Oxenford)—

Following are notes you require on the grasses mentioned in your letter:—

1. Perennial rye grass (*Lolium perenne*)—A native of Europe. Generally speaking, the most prized of all the rye grasses, but not particularly persistent under Queensland conditions.

2. Wimmera rye grass (*Lolium subulatem*)—a native of Central Europe and the Mediterranean regions. It first gained some reputation in Australia in the Wimmera districts of Victoria; hence the local name. There it is largely used as winter grass for sowing on worn out wheat lands.

3. Western Districts rye grass—A variety of this grass that we understand comes from the Western districts of Victoria. Hence the local name.

4. Commercial rye grass (*Lolium perenne*)—A form of No. 2, various strains of which are in cultivation.

5. White clover (*Trifolium repens*)—A native of Central Europe and temperate Asia, now widely spread over most warm temperate countries. It is a perennial species, and probably best of all the clovers grown in Queensland.

6. Bokhara clover (*Melilotus alba*)—A plant with a very wide distribution in the southern hemisphere. The typical form is a biennial, though annual strains are frequent. Like common melilotus it possesses rather a distinctive odour and flavour, and stock have to become accustomed to it before they take to it readily.

7. Subterranean clover (*Trofolium subterranean*)—A native of western and southern Europe. It plays no important part in agriculture in its native countries, nor in North America, where it has been introduced, but in the southern States of Australia this plant has proved itself one of the most useful and important factors ever introduced, especially for the improvement of the carrying capacity of second class country. It is of annual duration.

8. Burr clover (*Medicago denticulata*)—a native of southern Europe. An annual clover that does remarkably well under Queensland conditions. The only drawback to it is that the burrs cause some trouble in sheep country, particularly infesting the belly wool, but probably the plant's good points outweigh its bad.

9. Sheeps Burnett (*Proterium sanguisorba*)—Native of southern Europe and the Mediterranean region. A perennial plant of remarkable persistence under Queensland conditions.

Sandalwood.

R.H.F. (Bowenville)—

Santalum lanceolatum, Queensland sandalwood. This is quite different from the tree usually called sandalwood on the Darling Downs. It is identical, however, with the tree the timber of which is exported extensively from North Queensland. For many years we thought that the southern trees did not possess any scented timber, but the larger specimens when cut into are found to possess a heartwood with quite a strong sandalwood odour. Plum tree and damson are names sometimes given to this tree or shrub, and it is generally regarded as being quite useful as a stock fodder. Some of the fruits you mention are galled.

Prickly Supple Jack.

A.T.M. (Dayboro')—

The specimen is *Smilax australis*, sometimes called the prickly supple jack. It is a member of the family *Liliaceæ*, and is closely allied to the plant that produces the sarsaparilla of commerce.

Central District Plants Identified.

A.A. (Rockhampton)—

1. Leaves only, but we think they are of the white cedar *Melia dubia*. Would like to see later on in flower to make sure, as there are some imported trees with similar foliage. We presume, however, that this is a native.

2. *Chenopodium ambrosioides*—Worm Seed. A native of the warm parts of America now a very common naturalised weed in Queensland. The seed of this and allied species provide worm seed oil, which is extensively used in the hookworm campaign and generally as an anthelmentic.

3. *Eclipta alba*, a very common weed in parts of Queensland, not known to possess any poisonous or harmful properties.

4. *Solanum sp.* No flowers or fruit, therefore not possible to tell the species, but one of several prickly species of solanum known in Queensland as devil's needles. We have not heard of its being harmful to stock in any way.

5. *Solanum verbascifolium*—wild tobacco. A very common tropical weed in Queensland, particularly as second growth. The berries seem to be eaten freely by poultry as they fall from the bushes, and so far as we know have not caused any trouble.

6. *Acanthospermum hispidum*—star burr—a native of tropical America, now a naturalised weed in many warm countries. It is one of the worst weed pests of North Queensland.

Burnett Specimens Identified.

A.D. (Bundaberg)—

The specimens have been determined as follows:—

1. *Themeda australis*—kangaroo grass. One of the best-known grasses in coastal Queensland; it does not stand heavy stocking, although strains that stand heavier stocking than usual have been reported to us from time to time. This is one reason why the grass is so common along railway lines.

2. *Dicanthium sericeum*—blue grass. Various forms of this grass occur in Queensland, some coastal and some inland. It is generally regarded as an excellent fodder, but not particularly drought-resistant.

3. *Asclepias curassavica*—milky cotton bush. Also called red head or yellow oleander; a native of West Indies and tropical America, now a naturalised weed in Queensland. It has been proved by feeding tests to be poisonous to stock, although generally speaking they rarely eat it in sufficient quantities to cause trouble.

"Headache Vine."

M.E.H. (Murgon)—

The specimen is *Clematis glycinoides*, the headache vine. It is a native plant, and is fairly common in different parts of Queensland. The local name arises from the fact that if the green leaves are crushed in the hand and inhaled strongly, an irritation is set up somewhat similar to pepper being thrown at the nose. The eyes and nose start to run, and the headache is said to be cured. The plant has not been investigated chemically so far as we know.

Land Measurement.

B.G.—

With a width or frontage limit of 1½ chains the depth of ¾ of an acre would be 5 chains.

General Notes

The Late Mr. Dignan—A Fine Tribute.

In his annual report to Parliament, the Public Service Commissioner, Mr. J. D. Story, I.S.O., pays a moving tribute to the memory of his late Deputy. Mr. Story writes:—

By the death on 18th July, 1936, of the Deputy Public Service Commissioner, O. J. H. C. Dignan, B.A., after a brief illness, the country suffered a severe loss. As he was but fifty years of age, he had, in ordinary course, many years of usefulness in store. He was steeped in Public Service lore, mature in experience, and wise in judgment. With him, knowledge had come but wisdom had not lingered. The man has gone but his memory will live and be cherished. Mr. Dignan's career was an inspiration; though the State Service has lost by his death, his life has enriched its traditions.

Trans-Border Stock Restrictions.

In a recent statement made by the Minister for Agriculture and Stock (Mr. Frank W. Bulcock), he expressed the opinion that certain restrictions now placed on the entry of Queensland stock into New South Wales could, with advantage, be reviewed, and accordingly instructions were issued for the Chief Inspector of Stock (Colonel A. H. Cory) to confer with the Chief Veterinary Surgeon, New South Wales, on the matter.

As a result of representations made by this State, it is now probable that cattle from the tick-infested area in Queensland, known as Schedule "S," if travelled on the hoof, will be permitted entry into New South Wales on one dipping, under supervision, prior to departure from the centre where they are depastured, and another at the crossing place prior to entry into New South Wales, and the present restriction requiring their detention on the Darling Downs for a period of two months will be waived. The Minister pointed out that this concession should be of considerable advantage to stockowners consigning cattle to New South Wales. It is also understood that the New South Wales authorities will permit bona fide working horses and horses from Toowoomba and other tick-free centres to enter New South Wales at Tweed Heads, after spraying instead of dipping as is now insisted upon.

Confirmation of these modifications of the Regulations is now awaited from the New South Wales authorities.

Another Northern Wild Life Sanctuary.

Milray lagoon and swamp, on Milray Station, Pentland, has been declared a sanctuary under the Animals and Birds Acts.

Sugar Levy.

Regulations have been issued under the Primary Producers' Organisation and Marketing Acts, empowering the Queensland Cane Growers' Council to make a particular levy on all cane growers at the rate of one penny per ton of sugar cane harvested during the current season, the amounts raised by such levy to be expended on matters of an economic, legal, or compensatory nature, where such matters are of vital importance to the sugar industry generally.

Growers are given an opportunity of petitioning, on or before 5th October next, for a poll on the question of whether or not the above levy should be made.

Staff Changes and Appointments.

Mr. L. G. Walker, Inspector of Stock, Cunnamulla, has been appointed also an Honorary Ranger under the Animals and Birds Acts.

Mr. J. A. Mobbs (Ormeau) has been appointed an inspector under the Diseases in Plants Acts, Department of Agriculture and Stock.

Mr. M. Custance, Slaughtering Inspector, Coolangatta, has been transferred to Southport.

Mr. W. P. Hamon, Clifton Station, Ubobo, has been appointed an Honorary Ranger under the Animals and Birds Acts.

Mr. E. C. Dunn, Inspector of Stock, Boondooma, has been appointed also an Inspector of Dairies, and Messrs. F. T. Heers and J. V. Smith, Inspectors of Dairies at Bundaberg and Murgon, respectively, have been appointed also Inspectors of Stock.

Messrs. D. M. Corbett and H. J. Heidke have been appointed assistant cane testers for the balance of the sugar season at the Invicta and Farleigh sugar mills, respectively.

Messrs. E. M. Catherwood (Day Dream Island) and A. Shepherd (Milray Station, Pentland) have been appointed honorary rangers under the Animals and Birds Acts.

Mr. L. E. Nichols, Assistant to Dairy Bacteriologist, Department of Agriculture and Stock, has been transferred from Brisbane to Toowoomba.

Mr. E. F. Duffy, Inspector in Fruit Culture, has been transferred from Bowen to Manly; Mr. S. F. Kajewski, Inspector, Diseases in Plants Acts, from Brisbane to Bowen; and Mr. J. A. Mobbs, Inspector, Diseases in Plants Acts, will be attached to Brisbane.

Messrs. M. Buchanan, Gympie, and K. R. Hack, Nerang, have been appointed Growers' Representatives on the Banana Industry Protection Board until the 30th September, 1937.

Mr. K. M. Ward, M.Agr.Sc., of the Department of Agriculture, Victoria, has been appointed Assistant Horticultural Research Officer, Department of Agriculture and Stock, Brisbane.

Mr. C. R. Mulhearn, B.V.Sc., Government Veterinary Surgeon, Department of Agriculture and Stock, and Mr. G. D. Daly, Assistant Bacteriologist, Animal Health Station, Yeerongpilly, have been transferred to the Animal Health Station, Townsville.

Mr. A. McDowall, Stock, Slaughtering, and Dairy Inspector, has been transferred from Coolangatta to Gladstone.

Farmers' Assistance (Debts Adjustment) Act.

A Proclamation has been issued under "*The Farmers' Assistance (Debts Adjustment) Act of* 1935" appointing the 31st March, 1937, as the date within which any farmer who proposes to effect a composition or scheme of arrangement with his creditors in satisfaction of his debts, or part of them, may make application to the Rural Assistance Board for assistance to give effect thereto.

Honey Board Levy.

A Regulation has been issued under the Primary Producers' Organisation and Marketing Acts extending the Honey Board Levy Regulations published on 14th April, 1934, for the period from 1st April, 1936, to 8th March, 1939. The levy applies to all growers of honey and beeswax, and is at the rate of 1½ per cent. of the proceeds from sales.

Rural Topics

Worms in Sheep.

Within recent years, the problem of control of the parasitic worms in sheep has been given a good deal of attention in various parts of the world, more especially in South Africa, England, and Australia. Previously, treatment by means of drugs was successful only in the case of the stomach worm. Worms inhabiting the small intestine, e.g., the hair worms, and the large bowel, e.g., the nodule worm, were practically unaffected by drugs given in the ordinary way through the mouth.

The inefficiency of administration of drugs given through the mouth against hair worms and the nodule worm was found to be due to the fact that, under the conditions usually accompanying treatment, the drug passed into the first stomach or paunch and thus became diluted to such a degree that by the time it passed through the three remaining stomachs of the sheep it reached the intestine in too weak a concentration to be in any way effective against the worms situated there or lower down in the gut.

The process of swallowing in sheep is governed by a groove which passes from the gullet along the roof of the first and second stomachs and eventually into the fourth stomach, which then leads directly into the small intestine. When the sheep grazes, the food is passed directly into the paunch, to be later brought back into the mouth, chewed as a cud, and then swallowed again. This time, however, the groove closes and the thoroughly masticated food goes direct to the third stomach or bible and then is passed on with little delay into the fourth stomach or rennet. When the sheep drinks, the groove is again closed and the water passes almost directly into the fourth stomach. It was therefore considered that if some way could be found of getting this groove to close during treatment, the drug would pass directly into the fourth stomach and would reach the worms in the small intestine and large bowel in a sufficiently high concentration to kill most of them.

After a large number of experiments, copper sulphate was found to produce this effect. Various strengths from 1 per cent. to 10 per cent. were tried, and it was found that a very small quantity of a 5-10 per cent. solution gave very consistent results. This work was carried out simultaneously in Australia and South Africa. For the small hair worms, nicotine sulphate was then combined with the copper sulphate, and very excellent results were obtained. This drench was found to be effective against stomach worms and tape worms as well. Another point which was brought out by this work was that starvation before drenching was not desirable. It was previously considered that by a starvation period prior to drenching, the locality in which the worms were present would be rendered free of ingested food and thus allow better contact of the drug with the worms. Actually, it was subsequently found that this effect was more likely to be obtained without starvation, for with starvation the animals brought up the food from the first stomach, ruminated it, and then swallowed it into the fourth stomach, thus surrounding the worms therein and in the small intestine with the ingested material Details of this treatment may be obtained on application to the Animal Health Station.

In South Africa, work along these lines has been continued against nodule worm. It was found that by first placing in the mouth 2½ c.c. of a 10 per cent. copper sulphate solution the groove closed, and then by giving immediately afterwards a powder of copper tartrate, copper arsenate, and calcium hydroxide, a high efficiency against the nodule worm could be secured by two treatments on successive days. This treatment is now being tested in Australia, and is not yet available to the grazier.

Champion Large White Sow Farrows Large Litter.

The champion Large White sow, "Grinton Sunbeam," imported from New Zealand by Mr. J. A. Heading, of Murgon, and regarded as the best sow of her breed yet exhibited at a Queensland show, farrowed a litter of nineteen pigs soon after the Brisbane Exhibition. Some doubt was felt as to the wisdom of transporting this sow by rail to Murgon when it was known she was within a day or two of the due date for her litter, but Mr. Heading decided to take the risk, making special provision for the comfort of the sow in a railway waggon. Two of her first litter were also prize-winners at the Exhibition, indicating her capacity to reproduce her excellence.

Grow More Passion Fruit.

There is a very much greater demand for passion fruit, both locally and for export, than Queensland produces, and as this State grows a passion fruit of the very highest quality, it should be produced to a greater extent than it is. As an occupation on the orchard, it is one of the most pleasant. Previously, production of this fruit has been chiefly undertaken as a sideline only—a kind of secondary affair, which, if it yielded a return, so much to the good; if it didn't, well, it did not matter a great deal. With the ever-expanding demand, it warrants being made a principal crop, and being subjected to kind treatment.

Vines are prone to several diseases, which, with proper attention, can be controlled, but which, when the vines are allowed to grow uncared for, quickly destroy them. Due to these diseases and the haphazard method of cultivation frequently employed in the past, the idea has become current amongst the orcharding community that vines can only be grown for about two, or at most three years. That this is erroneous is being demonstrated at the present time by vignerons who have made passion fruit growing their main occupation, and who have vines bearing well at seven years of age. These growers, however, prune correctly, and spray at the correct times, as advised by the Department. They also grade and pack their product for market, and the result is they are reaping the benefit of an excellent monetary return.

It is stated by some that passion fruit growing entails too much work pruning and spraying, and the results are not worth it. A careful analysis of the position will refute such statements. Pruning the vine undoubtedly is a tedious and lengthy operation. Spraying also is objectionable, but remember that citrus growers, grape growers, and practically all other kind of fruitgrowers must also prune and spray their trees. So far as returns are concerned, good vines produce up to half a bushel of fruit per year. They are usually planted 15 feet by 8 feet apart, or 363 vines per acre. Prices vary from 22s. 6d. per half-bushel during the periods of scant supplies to 4s. 6d. per half-bushel paid by the local factories. From these figures orchardists can estimate for themselves the likely returns. On a conservative average of 3s. 6d. per half-bushel clear of marketing expenses the return would be £63 per acre per annum. Are there many other fruit crops netting orchardists this sum per acre?

A pamphlet giving full cultural details is available free on application to the Department of Agriculture.

Briefly, for the guidance of those who may be considering planting, it should be remembered that the passion vine is a climber, and thrives in warm, moist situations, preferably in the coastal districts. It grows well on the coastal highlands, like the Blackall Range and Tamborine Mountain, and also on the lowlands between these and the sea. The vine will resist light frosts, but heavy frosts will cause damage.

Reasonably fertile scrub and forest loams, provided they are well drained, are suitable soils, and if a hillside site is chosen, it should be well sheltered from heavy winds and preferably have an easterly or north-easterly aspect. It is important that the trellises be strongly made, and that they be at least 6 feet in height.

Two crops are borne each year—a summer and a winter crop—whilst occasionally intermediate crops are borne.

Spring is the best time to plant, though autumn planting is sometimes practised. Spring-planted vines sometimes return a small crop the following winter, but the first main crop can be looked for twelve to fifteen months after planting. With autumn-planted vines the first main crop is often not obtained until eighteen to twenty-one months after planting.

Cream Supplies—An Unwise Practice.

An unwise practice which has been indulged in by a few dairy farmers, has been reported during the week. This is the addition of water to cream, in the hope that it will be weighed and paid for as cream. If the practice were not so serious and full of potential danger to cream quality, it could be dismissed as ridiculous; but it is a serious matter and farmers should take heed of this note of advice.

The addition of water to cream is in no way beneficial, for the following sound reasons:—

(*a*) All cream arriving at a factory is tested by the Babcock Test, which indicates the total amount of fat that is in the can. The addition of water cannot possibly increase this amount of fat. What it does, in fact, is to lower the fat percentage or test of the cream.

(*b*) Addition of water means increased freight to the farmer.

(*c*) Water of doubtful purity, if added to cream, will seriously spoil its quality, and lower grades mean smaller cream cheques.

(*d*) Last but not least, there is a penalty attached to such malpractices.

There is nothing to gain and plenty to lose in the playing of such a game.

Sweet Potatoes.

The initial preparation of the areas intended for summer cropping should have been completed ere this, seeing that the rains essential for the carrying out of such work satisfactorily were experienced some time ago.

Planting of English potatoes will be in full swing in areas not subject to late frosts, and a prospective planting of sweet potatoes on those farms having suitable soils should now be commenced. Why this crop continues to be neglected to the extent it is is very difficult to understand. At the present time in the coastal areas it is not grown to anything like the extent its value as a stock food warrants, though it is not in this section alone of the State, but in the Western farming districts where its utter absence as a farm crop is more difficult to understand, more particularly when the suitability of the lighter soils found there and the ability of the crop to yield under droughty conditions are taken into consideration. In these localities, not only are the tubers capable of furnishing a first-class fattening food for pigs, but varieties can be grown which would with the proper storing of tubers, provide the farmer's table with at least one admirable vegetable over a goodly portion of the year. In addition to this, it is claimed in some quarters that the vines make excellent cattle food, though considerable care is recommended in respect of this, as cases of supposed stock poisoning have been reported from time to time as a result of eating the vines.

Although a sandy soil rich in organic matter is the most suitable type for this crop, any soils, other than clayey, which are wholly unsuitable, will give good returns.

As with other crops, success depends upon the preparation of the land for its reception. In this instance, the initial working should consist of ploughing as deeply as the nature of soil will admit. The secondary preparation should consist of its being worked to a depth of about four inches. Sometimes it is possible to defer the second working until planting is contemplated, enabling the two operations being carried out together, but this is controlled more or less by the condition of the land as to weeds, the period of the season, and the stage reached by the cuttings.

Work Among Bees.

In the Queensland coastal districts the bees are now commencing their activities outside the hive, but in more inland districts and on the Downs, the active season will not begin until this month.

With the opening of the earliest spring flowers and the accompanying rise in temperature, the bees venture forth to get the small amounts of nectar and pollen thus provided. As the weather becomes warmer the supplies rapidly increase, and the bees are greatly stimulated to build up the colony. Brood-rearing begins as soon as the new supplies come to the hive, and as the first bees emerge they in turn increase the capacity of the colony for brood-rearing, so that with a good queen and other favourable conditions, the amount of brood is rapidly increased.

The main object of the work in the spring is to ensure an abundance of bees in time for the coming honey flow, but during early breeding the bees should be disturbed as little as possible. In order to ascertain whether the bees have sufficient stores, the weight can be judged by tilting or lifting the hive, or the size of the cluster may be ascertained without breaking the propolis which seals the cover by looking at the combs from below.

On the first examination, which should take place when all danger of frosts is past, the beekeeper should look especially for queenless colonies. If any are found, it is best to unite these with normal colonies if queens are unobtainable. When uniting, two weak colonies should not be placed together, but a weak colony may be united with a strong one. If desired, the number can be restored later on, by subsequent division. The beekeeper should also examine the stores, for bees require large amounts of food during the spring, and, while they usually obtain considerable nectar outside, it is rarely enough to provide stores for the very rapid rate of breeding that is necessary at this time. If food is needed it may be given rapidly in the form of thick sugar syrup, or it is even better to provide combs of honey.

For those who are desirous of increasing their apiaries, this is a good time to purchase additional colonies, although the prices asked now are usually higher than those ruling in the autumn months. Bees purchased now are not only easier to transport while the weather is still cool, but they may also be expected, during normal seasons, to bring in an immediate return. If the hives are to be moved by motor truck, the combs should be placed parallel with the axle, but if it is intended to transport them by rail, the combs should be parallel with the rails.

Black Scurf or Rhizoctonia Disease of Potatoes.

Black scurf or Rhizoctonia disease of potatoes has been very prevalent in many consignments of seed potatoes arriving in Queensland during recent months, the presence of that disease resulting in numerous condemnations.

This disease receives its common name from the fact that the fungus causing it is present on the tubers as small black lumps very similar to small lumps of soil. They are easily distinguished from lumps of soil, however, by the fact that when wet they are deep black and are not easily washed off. These black lumps are the sclerotia or resting bodies of the fungus. The presence of these resting bodies on table potatoes would not cause an appreciable decrease in their market value.

If potatoe seed bearing these black lumps is planted, the resting bodies throw out cottony threads of fungus, which may grow up to the young potato shoots, attacking them at about ground level or even higher up, causing a rotting and dying away, or in the dry weather a wilting and shrivelling. The plant throws out more shoots which are usually small and stunted, giving it a bunched appearance. Aerial tubers may be borne on these shoots. The fungus may attack the plants in a very young stage, causing "misses" in germination. Affected plants produce few and small tubers, and yield is reduced very considerably if infection is severe.

As can be seen from this description, the disease is carried on the seed by the black resting bodies of the fungus. The fungus, however, once introduced into an area, is capable of attacking plants other than the potato and is able to remain alive in the soil for a number of years. By treating the potato seed before planting the black resting bodies of the fungus can be killed, but if the treated seed is planted in soil which already has the fungus in it some diseased plants must be expected.

In order to prevent losses from black scurf a rotation of crops should be practised, and seed selected which is free from this and other forms of scab. As an additional precaution the seed may be treated on the farm with either of two fungicides, namely, acidulated corrosive sublimate or hot formalin solution. Particulars regarding these treatments may be obtained on application to the Department of Agriculture and Stock.

A Substitute for Milk in Pig Feeding.

Once again at this time of the year most pig raisers are faced with the problem of feeding pigs with little or no milk. It is generally known that meatmeal is a good substitute for separated milk in the pig's diet, but unless it is used carefully, meatmeal may prove an expensive food.

Meatmeal, which is a by-product of abattoirs and meatworks, is sold under several trade names and some varieties contain a small percentage of bonemeal. It is a wholesome food, convenient to use, and costs from 9s. to 10s. 6d. per 100 lb. bag, Brisbane, the higher-priced brands containing a higher percentage of protein.

As meatmeal is so expensive in comparison with other pig foods, it should not be used more freely than is necessary.

Separated milk, which meatmeal replaces, is used according to its availability, pigs sometimes receiving milk as their sole diet, but actually pigs will thrive on very small quantities of milk used in combination with grain and other foods such as pumpkins and sweet potatoes; the milk supplies a large part of the protein necessary to balance the ration. Each pig from weaning until baconer stage and each dry sow should receive a minimum of three-quarters of a gallon of separated milk daily, and each sow with a litter double that quantity.

When these minima quantities of separated milk are not available, meatmeal may be substituted, using ½ lb. of meatmeal to replace each three-quarters of a gallon of separated milk.

Pigs thrive on a mixture of milk and meatmeal, or meatmeal alone as the protein-rich portion of the diet. The quantities used should not exceed from ¼ to ½ lb. daily per pig from weaning to baconer stage, according as to whether good lucerne is available or not; and ½ lb. for each dry sow and 1 lb. daily for each sow with litter.

By feeding a constant quantity of separated milk or meatmeal, and increasing the grain and other foods according to the pig's appetite, the nutritive ratio is automatically widened as the pig grows and satisfies its requirements.

In cases where pigs have access to good young pasture or green crops, the minimum quantity of separated milk or meatmeal stated above may be reduced by up to 50 per cent., depending on the quality of the green foods.

Meatmeal may be fed dry or mixed with milk or water.

The Apiary.

Now that the days are becoming warmer, it is desirable that all the hives should be thoroughly cleaned. This is best effected by providing a clean spare hive, and transferring to it the frames, one by one, after scraping the wax and propolis from the top bars. The hive thus emptied is then thoroughly cleaned, all the burr-comb, propolis, wax, moth cocoons, and other debris removed, after which it is ready to accommodate the frames and bees from the second colony. This change into a fresh hive is continued throughout the entire apiary, taking care, however, that the original position occupied by each hive is not altered.

When the colonies are being overhauled, any hives that are leaning should be levelled up, as this will result in straighter combs being built. The queens should also be looked for, before the colonies become more populous. Note their age, and if, from the small size of the brood nest, their egg-laying capacity appears to be declining, their hive numbers may be entered in the notebook as being among those which require requeening.

At this time any faulty combs that do not contain brood may be removed. If brood be present, the faulty comb should be gradually moved outside the cluster to the side of the hive, and then removed after all the brood has matured. The spaces may be filled with frames containing full sheets of foundation, as the hives should never be left without their full complement of frames.

One of the chief aims in manipulating bees is to endeavour to have them at their maximum strength at the time of the chief nectar-flow. Observations of the local flora, with a careful note of the buds showing on the various eucalypts or other trees, together with a record of the rainfalls and climatic conditions generally, are good guides in this respect. If the chief flow occurs early in the season, preparations should have been made during the previous autumn to see that each colony possessed a young queen, and that they had sufficient stores. The ideal to strive for is two full-depth bodies filled with brood, and if this strength can be built up just before a nectar-flow, the bees will fill two or even three honey supers, as a young, high-grade queen will be able to keep two hive bodies filled with brood during an average season. As the consumption of stores by weaker colonies is just as great as by strong ones, and as they give less surplus honey, it is evident that a moderate number of strong colonies is a better business proposition than a larger number of weaker ones, besides requiring less work. Furthermore, an apiary containing colonies of even strength is an indication of the beekeeper's skill and good management.

Metallic Flavour in Butter.

The metallic flavour in butter may have several causes. Among them is the condition of or care bestowed on the various pieces of machinery used in neutralising, pasteurising, and holding cream. As a rule the metal surfaces of all cans, pasteurisers, and vats are kept in a first-class condition, but it sometimes happens that farmers, manager, buttermakers, and others are a little too eager to substitute some strong alkali washing powder for elbow grease. By sprinkling the dry powder on the metal surface of the vat, coil, or pasteuriser, they cause an undesirable chemical action, resulting in the solution of the tin coating, the exposure of the base metal, and the metallic flavouring of the butter. All persons responsible for this work are, therefore, advised strongly to always use only a very little diluted alkali washing powder in cleansing their machines and apparatus, and to rinse them thoroughly with clean, sterile water after washing them. It is a good plan to protect the tinware from strong alkali or metal brushes, or anything which scratches or corrodes the tinned surface. A rusty vat or can should not continue to be used, but should be replaced by one that is covered thoroughly with a good, clean, smooth coating of tin. Rusted and corroded tinware may be in use on a farm from which the cream is received, so that the butter factory management should not only investigate the condition of its own utensils, but insist on the cream being delivered to the factory in perfectly smooth, well tinned, seamless cans. This is a provision of the Dairy Produce Act.

Cream should be delivered before it becomes exceptionally sour, and not allowed to stand in either tin cans or vats for too long. Otherwise, the action of the high acid of the cream on the metal of the cans or the vat is likely to be responsible for a part of this metallic flavour. Cans that are too large for conveyance of cream to the factory, that is, say, an eight or ten-gallon can, with only one or two gallons of cream in it, should not be used, for metallic flavours are likely to arise through the cream splashing around the sides of the can during transport to the factory.

The Nutritive Value of Pasture Plants.

Numerous inquiries are received each year by the Department of Agriculture and Stock from dairy farmers and other stockraisers regarding the relative values of different grasses and clovers for cream production and for fattening stock. One inquirer might ask whether Kikuyu grass is as nutritive as paspalum; another query a report that some newly-discovered grass is as valuable a feed as lucerne. To all who seek information of this nature, three facts must be pointed out:—

1. Chemical analysis gives some idea of feeding value, but the grazing animal is the final judge.
2. Certain plants have a higher nutritive value than others.
3. Stage of growth has a marked influence on nutritive value.

With regard to the value of chemical analyses in comparing feeding values, it must be emphasised that palatability and digestibility are factors as important as the quantity of the different nutrients in each 100 lb. of the pasture. Obviously, if a plant is distinctly unpalatable, and entirely neglected by stock as a consequence, its feeding value is nil. Again, a particular plant might appear on its chemical analysis to have a high feeding value, yet actually be quite a poor fodder because of the indigestible nature of its chemical contents. Unfortunately, feeding trials to determine the exact value of each of the better known pasture plants would be expensive to conduct, and for the time being palatability and chemical analyses (the latter interpreted in a commonsense way) must form the basis of comparative tables.

It is quite well known that paspalum, Rhodes grass, Kikuyu grass, and lucerne, for example, are of much greater feeding value than spear-grasses, barbed-wire grasses, &c. Feeding trials probably would reveal the former series to contain a higher proportion of digestible nutrients than the latter series, and chemical analyses certainly point that way. Clovers and other recognised pasture legumes generally differ from grasses in possessing a higher proportion of proteins in relation to fats and carbohydrates, but are not necessarily of higher feeding value. Indeed, for all classes of stock a mixed ration of grass and clover (or other legume) is better balanced than a pure leguminous ration.

In recent years much evidence has been collected to show that pasture in its young state is much superior to mature pasture. Short young pasture is well provided with proteins, fats, carbohydrates and minerals all in a highly digestible form. With increasing age the protein and mineral contents fall, and indigestible fibre increases at the expense of the carbohydrates. For this reason, different plants cannot be compared on their chemical analyses unless the samples analysed represent material at approximately the same stage of growth.

Second-hand Bulls.

Second-hand articles are not in demand or favoured by most people. Rightly or wrongly, we have more or less prejudice against being second-hand owner of most things. There is a pride in original ownership, whether it be a fast horse, a record-making cow, or a prize pig. This matter of prejudice or pride may be carried too far, and work injury to live stock progress. Effort is being made by those who realise the value of a proven sire to get all breeders to appreciate the second-hand well bred dairy bull. Some breeders are already following the practice of using no bull except one that has proven himself a getter of good stock. That is the measure of a sire. It is not possible, of course, for all to select a bull that has a line of capable progeny behind him. The old bulls are passing on; new breeders are demanding bulls, and not all bulls should be kept. Plans should be made to keep all sires that have proven themselves getters of good stock, and use them as long as possible. It is not uncommon to find a string of good producing and well formed cows and their sire gone to the slaughter-house, because line-breeding was not considered desirable or because the bull showed signs of being wild. If all breeders appreciated proven blood, the second-hand good dairy bull would sell for more than the new untried bull. Selling a bull under the pretext that he is wild and dangerous is not a sufficient reason, for all bulls should be treated as though they were not to be trusted and provision should be made accordingly.

In the selection of a bull, pedigree records of his ancestors and their conformation, and his type should always be considered. All these items are valuable guides to the breeder who is looking for a bull to head his herd. The crucial test, however, can only be made through use, by seeing and knowing the capabilities of his progeny. It is quite possible for a bull to be well bred and yet be unable to pass his rich inheritance on to his offspring. In short, do not hesitate to purchase a second-hand bull if he is sound, well bred, and has proven himself a good breeder.

Fat Lamb Production.

Recognising that Queensland generally lags behind other States in the production of fat lambs, the Minister for Agriculture and Stock, some two and a-half years ago, inaugurated a scheme for the encouragement of this branch of the sheep industry. Rams of British breeds were purchased in the South and distributed to farmers who had cultivation or promised to cultivate. The necessity for cultivation was urged on all farmers, it being thought by officers of the Department that fat lambs off grass country, even if prime, were more or less in the nature of a fluke. The breeds purchased were Border Leicesters, South Downs, Dorset Horns, Shropshires, and Romney Marsh.

In certain cases where a farmer owned a stud ram of particular breed, stud ewes were supplied with the idea of fostering the breeding of pure stock.

All sheep supplied to farmers are on loan, and remain the property of the Department. The progeny and wool, however, are the property of the farmers concerned.

The interest taken in the scheme, and the results to date, have been highly gratifying, and it is now no uncommon sight to see a pen of true sucker crossbred lambs on sale at Cannon Hill. Prices, too, during the period under discussion have been generally profitable.

The greatest drawback to the production of fat lambs on the Darling Downs in quantity has been, in the past and still is, the difficulty of purchasing good crossbred ewes as the mother flock.

If a start has to be made with Merinos the best ewe for fat lamb raising is bred by the introduction of one of the long wools, such as Border Leicester, Lincoln, or Romney Marsh into the strong-woolled, robust type of Merino ewe. The ewe lambs of this drop should then be retained as the future dams of the lamb-raising flock.

As to suitable ewes for the fat lamb industry, it is believed that graziers on the fringe of the Darling Downs or further out would find it profitable to join long-woolled rams of British breed with their cast-for-age ewes with the idea of selling the progeny annually as fat lamb ewes on the Downs. Into the crossbred ewe flock, as described, should be introduced a ram of the Downs type. Opinions necessarily differ in the matter of crosses. The South Down is the fashionable lamb at the present time, but it should be remembered that this cross must suffer no check from birth to block. The Dorset Horn gives a very nice lamb, early maturing and hardy. The use of the Border Leicester should be encouraged in every way. In addition to an early-maturing lamb filling every want, it must be remembered that the skin value of this lamb is worthy of consideration to a far greater extent than either the Dorset or the South Down.

Pure-bred Corriedale ewes are hard to come by, but should the opportunity occur a farmer would be well advised not to let it slip. Pure Corriedales are hard to beat, good mothers and heavy milkers, besides growing a profitable fleece.

Generally, the wool from a flock retained for fat-lamb breeding is a secondary consideration when compared with the production of fat lambs.

Eradication of Old Tobacco Plants.

The degree of success achieved in the present efforts to establish an extensive and flourishing tobacco industry in this State will be dependent in large measure on the practicability of checking the ravages of various pests and diseases. So far as Queensland is concerned, leaf miner and stem borer constitute a very serious menace to success, and it is essential that the populations of these two insects carrying over from the old crop to the new one be reduced to a minimum.

Much can be accomplished by the elimination of breeding grounds during the months intervening between successive crops of tobacco, because in some of the more important tobacco districts practically nothing but tobacco is grown. Hence, if tobacco plants are uprooted and destroyed by fire as soon as possible after the completion of the harvesting of the leaf, and if volunteer plants are similarly dealt with, the new tobacco crop should get a good start free from any serious infestation. The position will be still further improved if the destruction of these tobacco plants is accompanied by the elimination of several leaf miner weed host plants, which occur in the main tobacco districts, and are botanically closely allied to tobacco. Again, from the point of view of insect control, the production of two tobacco crops in twelve months, which has been attempted in some districts, is fraught with great danger, at least in so far as the incidence of leaf miner and stem borer is concerned, and should be avoided on that account.

The procedure just recommended will, of course, also materially help to reduce the carry-over of tobacco diseases.

Pruning Custard Apples.

Many requests are made to the Department for advice as to the reason for the shy-bearing habit of custard apple trees. Incorrect methods of pruning, and particularly pruning at the wrong time, are in large measure responsible for the trouble.

Custard apple trees possess naturally a vigorous growing habit, and if severely pruned whilst dormant during the winter, respond during the following warm months with an excessive growth of new wood, with the consequent sacrifice of the crop of fruit. The correct time for pruning in order to ensure fruit production is, therefore, most important, and the operation should be delayed until the first rise of sap in the early spring months—in Southern Queensland usually about September. The rise of sap is indicated by the swelling of the buds along the branches and the appearance of very young foliage.

If left to grow unchecked, the trees have an unruly, straggling habit of growth, with the lower branches often resting on the ground. These should be cut away, leaving about twelve inches of space between the lowest branches and the ground. Any young growths arising from the main branches and tending to crowd the inside of the tree should be pruned out, whilst the long, whip-like terminal growths at the outside of the tree should be reduced by one-third to one-half their length in order to form a compact, well-shaped head.

Derris and Cube Sprays and Dust.

Insecticides prepared from a number of species of Malayan plants belonging to the genus Derris have come into favour during recent years. These plants are well known as a source of fish poison, both in Malaya and in the South Seas, where the natives pulverise the roots and throw the resultant powder on the surface of a pool or stream containing fish. The fish are stupefied, rise to the surface, and are then collected by the natives. It has been demonstrated that certain active principles in these plants are also highly toxic to some insects, and insecticides prepared from them possess the great merit of being safe for application to edible portions of plants due for harvesting at an early date. The derris insecticides act both as a contact spray or dust and as a stomach poison, and have given very satisfactory results against the common cabbage caterpillar, the onion thrips, and various species of aphids, including the cabbage aphis.

Cubé is the name applied to a group of South American fish poison plants, which are also a source of insecticides similar to those obtained from the genus Derris.

The derris and cubé insecticides are generally marketed as proprietary lines, and the firms selling the various brands usually supply full details as to the strength of application.

Milk from Newly-calved Cows.

With the approach of spring, dairy farmers should be careful regarding their increased milk supplies, especially colostrum milk. The milk of the newly-calved cow is abnormal, and is called colostrum or beastings. It is yellow in colour, has a rather strong pungent taste, an unpleasant odour, a sickly albuminous flavour, a high specific gravity, high total solids, high albumen, and low figures for fat and sugar. The fat of colostrum has different properties from that of normal milk, and the sugar is largely glucose and not lactose—it also shows a larger proportion of phosphate than normal milk.

Such milk serves only as food for the new-born calf, and not as a means for increasing the supply to the factory. Besides serving as food for the calf it also increases the resistance of the calf to disease during the first few days of its existence. The milk becomes more normal day by day until, in seven days after calving, it is practically normal, although it may take up to a fortnight to attain perfect normal composition.

It is advisable to isolate the newly-calved cows, and for the first seven days at least this colostrum milk should not be mixed with normal milk, either for butter or cheese. Cream from such milk blended with good cream results in the whole delivery being graded down either to second grade, or in being completely rejected. Therefore, do not separate this milk on any account. Colostrum milk is quite unfit for cheese-making, since it is easily coagulated by heat, curdles very slowly with acids and rennet, and results in very poor quality cheese.

Therefore, remember (1) colostrum milk is food for young calves only; (2) it should on no account be sent to cheese factories or as cream to butter factories.

Orchard Notes

NOVEMBER.

THE COASTAL DISTRICTS.

Citrus Fruits.

In the citrus orchard the increase in temperature and the possibility of a dry period call for the utmost attention to soil conditions, particularly aeration and moisture conservation. At the slightest sign of distress, owing to lack of moisture, trees should be thoroughly irrigated whenever water is available for this purpose.

At the same time care and attention should be given to cultivation, particularly on hillside orchards, and in the coastal districts the possibility of the approach of storms will prompt growers to consider the completing of each cultivation by forming shallow drains to care for excess water and prevent soil losses.

Attention must be given to the incidence of mites, which are the direct cause of the darkening of the skin of the fruit known as "Maori." Usually the first indication of the trouble is when, with the sun shining on it, the fruit has the appearance of being covered with a grey dust. If examined with a good lens, the skin will be seen to be covered with numerous yellow slug-like insects which are living on the skin.

Under certain weather conditions scale movement may be expected.

Detailed information regarding insect control may be obtained from Department publications on the subject.

Pineapples.

Continue planting pineapples as discussed in these notes last month, always remembering that the modern practice is smaller areas, close planting with more pineapples per acre, quicker, better, and more healthy growth, and finally better fruit by liberal fertilising through the leaf bases with 10-6-10. Taken all together, these recommendations tend towards the elimination of wilt.

Bananas.

New Plantings.—November and December are very suitable planting months in most districts. Just as modern methods have effected great improvements in pineapple culture, so they might be applied in principle to banana growing. Smaller areas and larger production per acre should cut overhead costs and lighten labour, lengthen the profitable life of the plantation, and reduce the time of waiting for the crop. To this end select planting material with care, plant in large holes, and break up the ground as soon as possible after planting. To prevent the loss of top soil by erosion and to provide the bananas with a cooler and moister environment, plant a cover crop as soon as weather permits, and initial weed growth has been suppressed. This will hold the loose surface soil during the summer rains.

Young Plantations.—The correct follower or followers for each plant should be selected, if not already done, and all additional suckers suppressed. Cultivate to conserve moisture and mulch with a cover crop. A complete fertilizer will improve the coming crop.

Old Plantations.—De-sucker to one follower to each plant. Apply a complete fertilizer, if not already done, and cultivate to conserve moisture.

General.—Bait for borers; be prepared for grasshopper and caterpillar plagues; watch for bunchy top.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

KEEP the orchards and vineyards in a thorough state of cultivation, so as to keep down all weed growth and conserve moisture in the soil. This is important, as if a long spell of dry weather sets in, the crop of summer fruit will suffer severely from the lack of moisture. Citrus trees should be irrigated where necessary, and the land kept in a state of perfect tilth. Spraying for codlin moth should be continued, and all pip fruit trees must be bandaged at the beginning of the month; further,

the bandages must be examined at frequent intervals and all larvæ contained in them destroyed. The neglect to spray thoroughly and to attend to the bandages properly is responsible for the increase in this serious pest in the Granite Belt, and growers are warned that they must pay more attention to the destruction of this pest if they wish to grow pip fruit profitably. Fruit fly may make its appearance in the cherry crop; if so, every effort should be made to stamp out the infestation at once, as, unless this is done, and if the fly is allowed to breed unchecked the later ripening crops of plums, peaches, apples, pears, apricots, and Japanese plums are bound to become more or less badly infested. Combined action must be taken to combat this the most serious pest of the Granite Belt, and growers must realise that, unless they take this action and see that careless growers do not breed the fly wholesale, they will never keep it in check, and it will always be a very heavy tax on their industry. Rutherglen bug is another serious pest in this district, and is propagated by the million by careless orchardists. The best remedy for this pest is to keep the orchard clean and free from weeds. Brown rot in fruit should be watched for carefully, and, on its first appearance in a district, all ripening fruit should be sprayed with the sodium sulphide wash.

All kinds of leaf-eating insects should be kept in check by spraying with arsenate of lead, and all grape vines, potatoes, and tomatoes should be kept sprayed with Bordeaux or Bungundy mixture, the former for black spot and downy mildew, and the latter for early and late (Irish) blight.

WHEN THE HORSE PULLS BACK.

The two methods for curing a vice in horses which have been handled badly as youngsters described below are from "1000 Handy Hints":—

(1) If you have a horse that pulls back on the reins when you tie him up, try this old dodge. Get a light rope and double it to form a crupper. Place the loop over his tail, and the other ends through the "D" on the saddle, then through the bit-ring to the post or rail. You should have to do this only a couple of times.

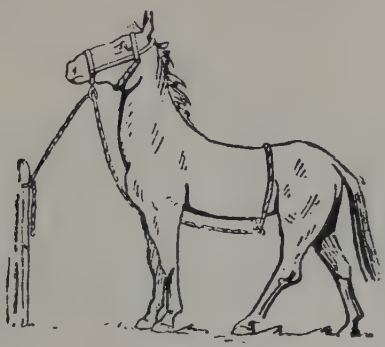


Plate 255.

(2) To cure a horse that pulls back when tied up and breaks reins and bridles, an effective method is practised in the Northern Territory, where abo-broken horses are often afflicted with the habit. A hitching-post is fitted with two strong ring-bolts, one about 18 inches above the other. To the top ring-bolt the reins are attached, but with cotton or thin string so that a tug will break them away. Round the horse's neck, close behind the head, is placed a close loop of rope, preferably plaited, and tied so that it won't slip and choke the nag. From this a strong thin rope is led through the ring of the bit, through the lower ring-bolt on the post, back between the prad's legs, over his back and across his chest to return between his legs, where a slip-knot is formed. As soon as the reins snap the horse finds himself suddenly and painfully caught by head and shoulders. After one or two experiences like that you can tie him up with a strand of spider web.

Farm Notes

NOVEMBER.

Field.—Farmers are commencing to realise that quick-maturing wheats which possess a degree of rust resistance are more dependable than the slow-growing and often rust-susceptible kinds, which are gradually giving place to these and mid-season varieties.

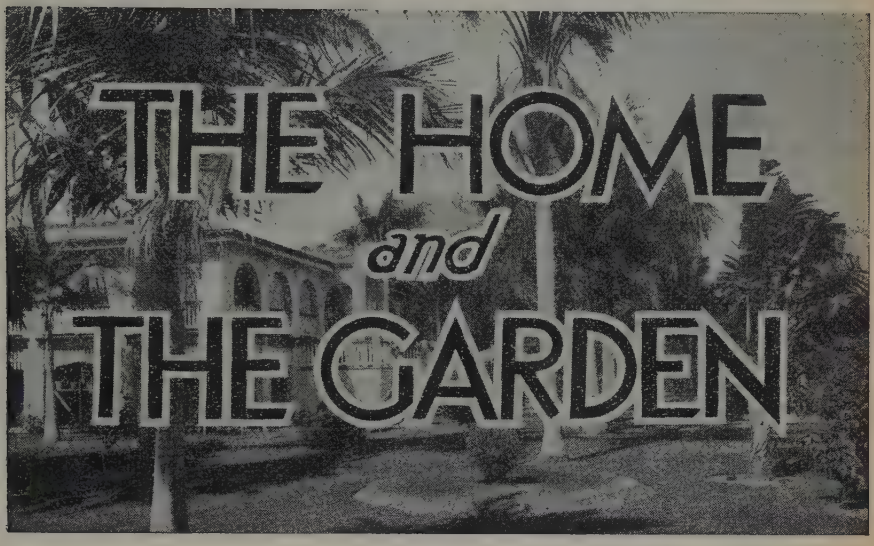
Growers are advised to make every preparation to work up the surface of the ground immediately after the removal of their crops, so that the soil may be put into good condition to receive any rain which falls, the conservation of which is the best guarantee for the success of the next succeeding crop. Such initial preparation also encourages the early growth of all foreign and weed seeds and permits of their eradication by the implements used to produce the desired soil mulch. In such manner paddocks are kept clean and the purity of crops is maintained. The careful preparation of areas intended for maize-planting cannot be too strongly impressed upon growers. Deep and thorough ploughing, followed by cross-ploughing and subsequent cultivation of the soil, must precede sowing if success would be attained; and all efforts must be concentrated to obtain a good surface mulch. Failure to follow up the subsequent sowings by harrowing prior to the appearance of the young plant conduces to weed growth and very often entails, by neglect of this operation, subsequent hand-hoeing between the plants in the drills. Harrowing should be discontinued before the plant breaks through the surface, otherwise damage will accrue to the tender shoots of the young plants. When the young maize plant has hardened up it may, with advantage, be lightly harrowed in the direction of the drills, but such practice must discontinue once the plant has attained a height of 6 inches. Close cultivation by inter-row cultivation implements is necessary after every shower to conserve moisture and to prevent weed growth, care being taken to ensure each cultivation being shallower than the preceding one, and so prevent damage to the root system of the plant, which is extensive. Inter-row cultivation should cease with the advent of the cob on the plant; and, if proper attention has been given to the crop, it should, at this period, be unnecessary. Where crops are planted on the check-row principle, inter-row cultivation is facilitated, and more even crops result.

The French millets (red and white), owing to their rapid maturing qualities, form excellent intermediate or supplementary crops, and are suitable for present sowing. Their value for fodder and seed purposes is worthy of more general recognition at the hands of the average farmer.

Past dry periods have impressed upon us the necessity of providing during good seasons against the return of less favourable ones, and in this connection the cultivation of quick-growing fodder plants appeals to us. Many varieties of useful classes of fodder can be cultivated over a large portion of this State; chief of which, perhaps, are the sorghum family for grain and fodder purposes. Of the latter, Sudan grass has much to commend it, and is fast becoming one of the most favoured by stockowners. Grain sorghums, of which Feterita, Red Kaffir, and the various Milos are examples, should occupy a more prominent position for purposes of horse and pig feeding, and are particularly suited to those localities which are unsuitable for maize production. Some varieties of sorghums have strong frost-resisting qualities, and lend themselves to those localities where provision for some form of succulent fodder is necessary during the winter months.

AN APPRECIATION OF THE JOURNAL.

A Kandanga dairy farmer writes:—"Herewith please find renewal for Journal—5s. for another five years. I must say it is a journal which every man on the land should not be without . . . . I would not let it drop as long as I am occupied on the land, and file every copy I receive for reference. Thanking the Department for the Journal, which I value . . . ."



OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

MOTHERING.

HOW important for the baby that he should have good "mothering" from his earliest infancy. The foundations of good conduct, self-control, in fact all the high qualities of character are laid down in infancy and childhood. "Mothering" includes all handling, feeding, and the mother's and guardian's whole attitude towards the baby. All babies are extremely sensitive to our way of touching them, to the tone of the voice, and the "atmosphere" we inevitably carry around with us. In an even, peaceful, loving atmosphere they thrive; in an atmosphere of unrest, worry, or irritability they either wilt or become nervy and irritable, too. Babies vary, and some are much more sensitive than others. A baby is quick to respond to the mood of the one who is handling him, but naturally he is in touch to the greatest degree with the mother who nurses him. Both mother and baby gather in a wonderful store of peace and health from these uninterrupted periods of calm. Baby seems to ask for very little in the first few months, just the right food at the right time, sleep, warmth, fresh air, and an atmosphere which allows him to grow naturally.

Regularity enters largely into good mothering. The whole universe works in rhythm, mother and baby are no exceptions to the great law of order. It is for this reason that we form a regular routine for baby with the fewest possible unnecessary breaks and changes.

Wise Loving.

He needs loving—an unloved baby shows it in his face—but it must be wise loving. This is, of course, a most difficult thing to achieve. It is hard to love unselfishly. Baby needs to be handled and loved and played with, but not just whenever his elders feel inclined to do so. Quite definitely it is bad for him during or after a feed. Many cases of vomiting are brought about by the injudicious handling of a newly-fed infant, by fondling, rocking, jogging, or jolting him, or stimulating him to smile, &c., immeditely after a feed. A healthy baby loves to lie awake talking to himself, playing with his hands or toes, growing and developing naturally and evenly. Do not disturb this precious time of healthy growth for both body and mind just for your own joy and entertainment in the responsive smile, the joyous chuckle. Undoubtedly it is hard, just because baby is so utterly lovable, responsive, and wonderful, but we are not looking very far ahead if we cannot restrain ourselves now for his ultimate good. If the nervous system is over-stimulated now, baby will grow fretful, irritable, and probably have digestive upsets. Even without these immediate results it means that he is not making the right beginning towards being the child who can amuse himself happily and independently, and who will be even-tempered, happy, and stable throughout life. Good "mothering" lays the proper foundations for the child, and the responsibility for good mothering lies with the parents.

Without a certain amount of talking to, handling, and nursing, baby would be slow and unresponsive. It is the meaningless movements of jogging, jolting, patting, etc., that are bad for him, and the absurd efforts and grimaces made to coax him to smile. Play is the natural joyous overflowing expression of an infant's growing intelligence. It may be gently encouraged, but it should always be spontaneous and not forced on the helpless little one.

IN THE FARM KITCHEN.

FRUIT DRINKS FOR SUMMER.

Among the following recipes for warm-weather drinks are many suitable for serving to small people, while grown-ups will find all of them palatable and refreshing.

Amber Fruitade.

Take 1 lb. loaf sugar, 2 large lemons, 2½ gills water, 1 grapefruit, 1 orange.

Measure sugar into a saucepan. Add the water. Stir occasionally, till sugar is dissolved. Bring to the boil. Boil for five minutes. Halve the fruit, carefully remove pulp and juice, and add to the syrup. Bring again to boiling point and allow to simmer round the edge. Skim carefully. When cold strain through a hair sieve or muslin. Add soda-water to taste.

Ben Fritski.

Take 1 cupful sugar, 1 pint cold water, 1 lb. tin grated pineapple, 1 orange, 3 lemons, 2 bottles ginger ale.

Boil sugar and water together for ten minutes. Add pineapple and the juice of orange and lemons. Strain, cool, and add chipped ice. Pour in ginger ale and serve.

Fruit Nectar.

Take 1 quart water, 2 cupfuls grapefruit, juice 4 oranges, 2 cupfuls sugar, juice 4 lemons, 1 egg-white.

Mix together the water and sugar. Heat to boiling point, then boil slowly for ten minutes. Cool, add grapefruit (cut into small pieces), lemon and orange juice. Freeze to a mash. Add stiffly-whipped egg-white, then chill for three hours, and use.

Fruit Punch (I).

Take 6 lemons, ½ cupful pineapple juice, 1 cupful weak China tea, aerated water to taste, 1 slice tinned pineapple, 2 mandarins, sugar, apple, and orange.

Squeeze the juice from the lemons. Strain and add the strained juice of the mandarins and pineapple juice. Pour into a tall jug. Add the tea, sugar to taste, and stand, stirring occasionally, until sugar is dissolved. Then add aerated water to taste. Serve ice cold, with diced pineapple and a few slices of apple and orange floating in the cup.

Fruit Punch (II).

Take 1 quart water ½ lb. sugar, 1 small tin pineapple, juice ½ lemon, 1 orange, maraschino cherries, cracked ice.

Boil together the water, sugar, and chopped pineapple for twenty minutes. Add the juice of half a lemon and one orange. When cold strain, add some maraschino cherries, and serve with cracked ice.

Fruit Lemonade.

Take 1 lemon, 6 strawberries or raspberries, sugar to taste, crushed ice.

Crush the strawberries well, add a teaspoonful sugar, the juice of one lemon,, and a little cold water. Strain into a tumbler, add a little crushed ice, and fill up with cold water.

Lemon Squash.

Take 1 lb. sugar, 1 pint cold water, 5 drops essence lemon, 2 oz. citric acid crystals.

Place in a pan the sugar and water, and bring to the boil. Boil quickly for four minutes. Remove from the gas and add the citric acid crystals and lemon essence. Stir till crystals have dissolved. Bottle when cool, and serve as required, with water or soda-water.

Orange Squash.

Take 3 oranges, 1 lemon, 3 tablespoonsful sugar, 1 pint cold water.

Cut the oranges in half and prepare two or three thin slices for garnishing. Squeeze the juice from the oranges and lemon, put into a jug and add the sugar. Allow it to stand for thirty minutes to dissolve the sugar. Add the cold water, garnish with slices of orange, and serve very cold.

Apple Water.

Take 4 large apples, 2 oz. castor sugar, 2 tablespoonsful lemon juice, rind of 1 lemon.

Peel the apples, cut them into slices, and put them into a jug with the sugar, lemon juice, and thinly cut lemon rind. Pour over the ingredients one quart of boiling water, cover, and allow to stand until quite cold. Strain and serve. This is a very refreshing drink.

Strawberry Water.

Take ½ lb. ripe strawberries, ¼ lb. sugar, ½ lemon, cold water.

Remove the stalks from the strawberries, crush them well and sprinkle the sugar over. Leave to stand for about three hours. Press the pulp through a fine sieve, add the lemon juice and one and a-half pints of cold water, and allow to stand for about two hours, stirring at frequent intervals. Strain and serve after standing on ice. This makes a good summer drink for children.

Nurseryade.

Take 4 lemons, 2 cupfuls castor sugar, 2 oranges, 1 quart boiling water.

Wash the lemons and oranges and cut the peel as thinly as possible from them. Place in a basin. Add water. Cover and stand for thirty minutes. Pour into a saucepan. Add sugar, and beat slowly till sugar is dissolved. Add strained orange and lemon juice. Bring to boil, and boil for three minutes. Cool and strain. Serve with additional water to taste.

Milk Lemonade.

Take 1 pint of cold milk, 2 pints boiling water, sugar to taste, 6 lemons.

Dissolve the sugar in the boiling water and pour it over the lemon rind, then add the lemon juice. Let it stand till cold before adding the milk.

Emerald Fruit Cocktail.

Take 1 pint grapefruit, grapefruit juice, ½ lb. seeded white grapes, 1 teaspoonful finely minced angelica, lemon juice, maraschino syrup to taste.

Mix the grapefruit pulp and juice with the grapes. Add a dash of lemon juice and maraschino syrup (or sweeten to taste), and stand till chilled. Divide between six sundae glasses and sprinkle with minced angelica.

HOW TO USE BANANAS.

Banana Glory.

Take one large ice cream block, 4 bananas, 1 tablespoonful lemon juice, 1 cupful thick cream, ½ cupful castor sugar, ½ teaspoonful vanilla essence.

Skin and mash three bananas to a pulp. Place them in a double boiler with lemon juice and sugar. Heat till almost boiling, then add vanilla and a pinch of salt. Cool. Whip the cream till stiff, then beat the banana mixture gradually into the cream. Stand till cold. Put a large ice cream block into a glass dish; pile the banana mixture on top, and arrange slices of the fourth banana round the dish. Serve decorated with halved marshmallows.

Banana Cream.

Take 6 bananas, ½ pint custard, 1 sponge sandwich, 1½ tablespoonsful raspberry jam, 2 tablespoonsful chopped walnuts, whipped cream, glace cherries.

Skin the bananas, then mash them. Add jam, crumbled sponge cake and walnuts, and mix well together. Place in a glass dish. Cover with custard, which must be cold. Pile whipped cream on top and decorate with glace cherries.

Banana Pasties.

Take 2 cupfuls flour, 2 teaspoonsful baking powder, 8 tablespoonsful butter or margarine, 1 teaspoonful brown sugar, 1 egg, 1 tablespoonful castor sugar, pinch of cinnamon, pinch of nutmeg, ½ teaspoonful salt, ½ teaspoonful butter, cold water, bananas.

First sift flour with salt and baking powder. Add castor sugar and rub in the eight tablespoonsful of butter (or margarine) with the tips of the fingers. Mix to a dough with very cold water. Roll out on a lightly floured pastry board to one-eighth of an inch in thicknesss. Cut into oblongs four and a half inches wide and six inches long. Lay a peeled banana on each piece of pastry. Allow one teaspoonful of brown sugar, pinch of nutmeg, and cinnamon, and half a teaspoonful of butter for each banana. Mix well and spread over each. Brush edges of pastry with cold water and press edges together. Place on a greased baking tin, brush with beaten egg, and bake for sixteen minutes.

Banana Mousse.

Take 4 bananas, 2 oz. sugar, 2 egg whites, ¼ pint cream.

Mash the bananas and sugar to a smooth pulp. Whip the cream until stiff and mix in with the bananas. Whip the egg whites until they are a very stiff froth and fold them into the mixture as gently as possible. Put the mousse into a glass dish and serve, after standing on ice for half an hour. Garnish with chopped nuts or grated orange rind.

Banana Russe.

Take 2 egg yolks, ½ pint milk, ½ oz. gelatine, ½ gill water, 2 tablespoonsful chopped bananas, 3 tablespoonsful sherry, some lady finger biscuits, 4 whole bananas, sugar to taste, whipped cream, and cherries to decorate.

Make a custard with the egg yolks and the half-pint of milk. Add sugar to taste. Mix in chopped bananas, the sherry, and gelatine dissolved in the water. When beginning to set, pour into a buttered mould, lined with split bananas and finger biscuits. When set turn out and decorate with whipped cream and cherries.

Banana and Pineapple Royal.

Take 7 bananas, ½ pint milk, 1 small tin pineapple, ½ oz. gelatine.

Peel six of the bananas and mash them to a pulp. Drain the syrup from the pineapple and put the fruit through a mincer. Dissolve the gelatine in a saucepan with half a gill of the pineapple juice. Add the remainder of the juice to the banana pulp. Stir in also the minced pineapple, leaving a little out for decoration. Strain in the dissolved gelatine, then add the milk and some castor sugar if necessary. Turn into a dish and leave to set. Just before serving heap some minced pineapple in the centre and add the remaining banana cut in slices. Serve with cream.

Cold Banana Pudding.

Take 6 bananas, rind and juice of half lemon, 1½ tablespoonsful castor sugar, 1 tablespoonful cornflour, 1 pint of milk, 1 large tablespoonful of apricot jam.

Mix the cornflour with half a gill of the milk. Put the remainder on to heat, with one tablespoonful of sugar and the grated lemon rind. When hot pour it on to the mixed cornflour, stirring well. Pour all back into the saucepan and boil slowly for six minutes, again stirring well to prevent it from getting lumpy. Peel the bananas, mash them with a fork, and put them into the bottom of a glass dish. Sprinkle the lemon juice and remainder of the sugar over the bananas; add the apricot jam, and mix all well together. When the cornflour has slightly cooled pour it carefully over the top of the bananas, &c., but do not allow it to mix with them. Sprinkle the top with crystalised violets, and serve when cold.

Banana Hedgehogs.

Take 4 bananas, apricot jam, desiccated cocoanut, 2 oz. almonds.

Heat some apricot jam, and, if very stiff, thin down with just a little water; then rub through a sieve. Peel the bananas and spread with jam, then coat with desiccated cocoanut. Blanch the almonds and split into pieces and arrange all over the prepared bananas.

Banana Honeycomb.

Take 4 bananas, 1 pint hot water, 1 pint packet vanilla jelly crystals, cochineal.

Dissolve the jelly crystals in the hot water and leave until it is beginning to set. Peel the bananas and mash them to a fine pulp, then add to the jelly and whisk all together for a few minutes. Stir in a few drops of cochineal. Turn into a wet mould and leave to set; then turn out on to a glass dish and serve.

Banana Twists.

Take 2 bananas, 2 oz. cornflour, 2 oz. castor sugar, 3 oz. margarine, 7 oz. flour, 1 egg yolk, vanilla flavouring.

Sieve the flour and cornflour. Peel the bananas and mash them very finely. Cream the margarine and sugar, then add the egg yolk and stir the mixture quickly for a few minutes. Stir in the mashed banana, flour, and cornflour, also a few drops of vanilla and mix all together to a stiff paste. Turn it on to a floured board and roll out. Cut into strips about 7 inches long and three-eighths of an inch wide. Twist each strip and cross the two ends. Place in a slightly buttered tin, put into a moderate oven, and bake gently until biscuit colour. They will take about fifteen minutes or perhaps a little longer.

IN THE HOME GARDEN.

SOME FERTILIZING POINTS.

Now that spring is here, renewed interest will be taken in the garden, which should be a feature of every farm home. Most soils can be made to produce successful gardens, points out a departmental pamphlet, though the process requires time, energy, some expense, and an appreciation of certain fundamental principles, as well as attention to such important matters as seed and plant selection, and insect and disease control.

Intensive gardening demands a higher degree of soil fertility than does ordinary field crop culture. An efficient system of soil management should not only make allowance for the present crop, but should aim at an ever-increasing reserve of fertility. It should determine the necessity and value for the particular soil of organic matter, how most economically to apply this material, then attempt to supplement this where necessary, by liming and the addition of artificial fertilizers.

For the maintenance of fertility the city gardener has to place his chief dependence on chemical fertilizers, and the grower who lacks information as to the plant food content of his soil, and who desires to grow a wide range of crops of whose requirements he knows little, should play safe by using a high-grade "complete" fertilizer, and give a liberal application. Though he applies more than the plants actually require, the increased cost is so light that the assurance of having enough is worth the additional expense.

A complete fertilizer is one supplying nitrogen, phosphorus, and potash in forms readily available to plants. A generally applicable complete fertilizer for home garden use consists of a mixture of dried blood, superphosphate and sulphate

or chloride of potash. These substances in the proportions by weight of 3, 4, and 1 respectively give a 5-11-6 fertilizer, or one containing 5 per cent. nitrogen, 11 per cent. phosphoric acid, and 6 per cent. oxide of potash. On light-textured soils potash could be increased by using the same substances in the proportions of 2, 3, and 1, when a 4-11-8 fertilizer would be obtained.

Dried blood has many advantages as a source of nitrogen. It does not damage seeds or seedling roots, becomes available when the root system is developing, and is therefore not lost. It is a useful basal form of nitrogen application, carrying plants up to the stage where it may be advantageous to apply forcing soluble nitrogenous fertilizers.

Sulphate of ammonia may be used in place of dried blood in the complete mixture, but should be used in two-thirds the quantity. The use of sulphate of ammonia results in loss of lime from soils, and in time develops strong acidity. These harmful effects are easily overcome by liming, but it is not advisable to use this fertilizer on acid, lime-deficient soils.

The tendency in home gardens is to use quantities of manure without the application of potash and phosphate, and results in a bad nutrient balance, which accounts for the frequent reports of plants producing excessive vegetative growth, with poor flower, fruit, or tuber production. Under such conditions the addition of a mixture of four parts of superphosphate and one of sulphate or chloride of potash would result in a better nutrient balance.

For crops such as lettuce, cauliflower, cabbage, Brussels sprouts, spinach, and celery, where vigorous growth must be maintained, liquid fertilizers can be applied when the plants are well established. The following flowers, provided a complete fertilizer has been used initially, have been found to respond to nitrogenous top-dressing:—Dahlia, chrysanthemum, calendula, Iceland poppy, sweet pea, primula, &c. The soil should be moist before the application of liquid fertilizers.

The most efficient forms of nitrogen for liquid application are nitrate of potash, nitrate of soda, or a mixture of these salts, and nitrate of lime. Sulphate of ammonia, phosphate of ammonia, or a complete liquid fertilizer consisting of nitrate of potash and superphosphate may be used. These substances are soluble in water (superphosphate will leave a considerable residue) and can be dissolved at the rate of 1 to 2 oz. per gallon, and the solution run along the rows from a water-can with the sprinkler removed, or applied with a measure in the case of larger, spaced plants.

If the liquid comes in contact with the leaves, these may be hosed down after the application has been made, to obviate the possibility of injury.

The practice of broadcasting fertilizers is wasteful, since much of it will not come within the absorbing range of roots. When seeds are planted in drills, these should be opened up several inches broad at the bottom and from 1 to 3 inches deeper than the seed is to be placed. The fertilizer is then distributed along the bottom of the row, at the rate of an ounce or two to the yard, the drill filled in to the desired depth, and the planting made.

With large growing plants that are spaced, such as tomatoes, cabbages, and potatoes, a hole a foot in diameter and several inches deep can be made with a spade, and a small handful of fertilizer scattered in the hole before filling in and planting above the fertilizer. Fertilizers for potatoes should be slightly below and in a ring about the tuber, rather than directly beneath it.

BOGGED STOCK.



Plate 256.

When a horse or cattle beast becomes bogged, take a pair of chains and hook them together. Then place them under the hindquarters, about the mud level. Tie a rope from one side to the other over the beast. To the end of chains A, hitch another horse, which will be able to pull the animal out without injuring it as is so often done when a rope is attached round the bogged animal's neck.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF AUGUST IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Aug.,	No. of Years' Records.	Aug., 1936.	Aug., 1935.		Aug.,	No. of Years' Records.	Aug., 1936.	Aug., 1935.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In
Atherton	0·90	35	0·04	1·76	Clermont	0·69	65	0·04	0·21
Cairns	1·75	54	0·10	2·85	Gindie	0·65	37	0·06	0·89
Cardwell	1·28	64	0·73	1·92	Springsure	1·04	67	0·10	0·40
Cooktown	1·22	60	0·32	1·40					
Herberton	0 65	50	Nil	0·75					
Ingham	1·41	44	3·60	0·86					
Innisfail	4 99	55	0·07	11·31					
Mossman Mill ..	1·37	23	Nil	0·83	*Darling Downs.*				
Townsville	0·51	65	Nil	Nil					
					Dalby	1·20	66	0·40	0·94
Central Coast.					Emu Vale	1·07	40	0·39	0·46
					Hermitage	1·15	30	..	0·45
Ayr	0·56	49	Nil	Nil	Jimbour	1·15	48	0·22	0·68
Bowen	0·65	65	Nil	0·05	Miles	1·10	51	0·36	0·81
Charters Towers ..	0·53	54	Nil	Nil	Stanthorpe	1·77	63	0·67	0·74
Mackay	1·04	65	0·13	1·00	Toowoomba ..	1·64	64	0·06	0·95
Proserpine	1·35	33	0·35	1·54	Warwick	1·44	71	0·51	0·62
St. Lawrence ..	0·81	65	Nil	1·06					
South Coast.									
					Maranoa.				
Biggenden	1·10	37	Nil	1·11					
Bundaberg	1·28	53	0·58	0·59					
Brisbane	1·98	84	0·10	1·64	Roma	0·91	62	0·48	0·59
Caboolture	1·54	49	0·08	2·21					
Childers	1·22	41	0·13	1·19					
Crohamhurst	2·22	43	0·10	4·96					
Esk	1·47	49	0·16	0·82					
Gayndah	1·16	65	Nil	0·83					
Gympie	1·72	66	0·01	1·73	*State Farms, &c.*				
Kilkivan	1·42	57	Nil	0·58					
Maryborough ..	1·69	65	Nil	1·16	Bungeworgorai ..	0·74	22	0·40	..
Nambour	1·89	40	0·36	4·62	Gatton College ..	1·11	37	Nil	0·51
Nanango	1·33	54	0·08	1·35	Kairi	0·91	22	..	..
Rockhampton ..	0·83	65	0·03	0·52	Mackay Sugar Experiment Station	0·88	39	0·10	0·68
Woodford	1·69	49	Nil	2·63					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—AUGUST, 1936.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Means Atmospheric Pressure at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·96	81	68	83	2, 3, 24, 31	58	26	32	4
Herberton	..	76	51	84	25	42	19, 20 21	Nil	..
Rockhampton	30·06	81	55	88	25	47	1	3	2
Brisbane	30·09	75	51	86	24	45	1	10	2
Darling Downs.									
Dalby	30·08	73	41	85	27	30	1	40	1
Stanthorpe	..	66	32	74	24	22	1	67	3
Toowoomba	..	69	42	80	27	31	1	6	1
Mid-Interior.									
Georgetown	29·99	89	55	95	26	45	20	Nil	..
Longreach	30·04	83	49	92	17, 26 27	40	6	10	1
Mitchell	30·07	75	40	89	27	31	1	39	1
Western									
Burketown	29·98	88	60	99	16	51	23	Nil	..
Boulia	30·03	83	52	96	24	45	b, 30, 31	Nil	..
Thargomindah	30·04	74	47	88	16, 24	40	10, 2	75	2

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	October. 1936.		November. 1936.		Oct., 1936.	Nov., 1936.
	Rises.	Sets.	Rises.	Sets.	MOONRISE.	MOONRISE.
					p.m.	p.m.
1	5·33	5·51	5.3	6.9	6·21	8.33
2	5·31	5·51	5.2	6.10	7·31	9.26
3	5·30	5·52	5.1	6.11	8·41	10.33
4	5·29	5·53	5.0	6.12	9·48	11.19
5	5·28	5·53	5.0	6.12	10·51	..
						a.m.
6	5·27	5·54	4.59	6.13	11·49	12.1
7	5·26	5·54	4.58	6.14	..	12.39
					a.m.	
8	5·25	5·55	4.57	6.15	12·41	1·11
9	5·24	5·55	4·57	6.15	1.23	1·43
10	5·23	5·56	4·56	6.16	2·3	2·16
11	5·22	5·56	4·56	6.17	2·35	2·45
12	5·21	5·57	4·55	6.18	3·10	3·16
13	5·20	5·57	4·55	6.18	3·40	3·52
14	5·19	5·58	4·54	6·19	4·11	4·29
15	5·18	5·58	4·54	6.20	4·41	5·11
16	5·17	5·59	4·53	6.21	5·17	5·58
17	5·16	5·59	4·53	6.22	5·51	6·49
18	5·15	6·0	4·52	6.23	6·30	7.41
19	5·14	6·1	4·52	6.23	7·13	8.36
20	5·12	6·1	4·52	6.24	8·0	9.37
21	5·11	6·2	4 51	6.25	8·52	10.35
22	5·10	6·3	4·51	6.26	9·46	11.34
						p.m.
23	5·9	6·3	4·51	6.27	10·44	12.35
24	5·8	6·4	4·50	6·28	11·43	1·36
25	5·8	6·5	4·50	6.28	12·42	2.41
26	5·7	6·5	4.50	6.29	1.45	3.49
27	5·6	6·6	4·50	6.29	2·49	4·59
28	5·6	6·7	4·49	6.30	3·54	5.59
29	5·5	6·7	4.49	6.30	5·1	7.16
30	5·4	6·8	4.49	6.31	6·45	8.17
31	5·3	6·9			7.23	

Phases of the Moon, Occultations, &c.

7 Oct.,	☽	Last Quarter	10	28 p.m.
15 ,,	●	New Moon	8	20 p.m.
23 ,,	☾	First Quarter	10	53 p.m.
30 ,,	○	Full Moon	3	57 p.m.

Apogee, 16th October, at 6.30 p.m.
Perigee, 2nd October, at 1.2 a.m.
Perigee, 31st October, at 12.36 a.m.

The only popular conjunction this month will occur on the 20th at 9 p.m. when the Moon in sickle-shape will pass Jupiter only about half a degree to the north of it. With the striking constellation Scarpio nearby a most interesting group of heavenly bodies may be seen. Jupiter is still in the narrow southern part of Orphiacus, slowly increasing its distance eastward from Antares, a fixed star of the 1st magnitude near the path of the planets.

On the 25th at 4 p.m. Mars and Neptune, in Leo, will be less than half a degree apart, Mars has traveled through nearly the whole constellation since the 3rd of September, while the far distant and apparently slowly advancing Neptune has been in that constellation since January, 1921.

A wide conjunction of Saturn and the Moon will occur at 1 p.m. on the 27th, an hour and 49 minutes before the Moon rises.

On the 31st Uranus, in Aries, will be in opposition to the Sun, rising as the Sun sets and vice versa.

Mercury rises at 5.25 a.m., 8 minutes before the Sun, and sets at 5.51 p.m. with the Sun on the 1st; on the 15th it rises at 4.32 a.m., 46 minutes before the Sun, and sets at 4.36 p.m., 1 hour 22 minutes before it.

Venus rises at 6.48 a.m., 1 hour 15 minutes after the Sun and sets at 7.44 p.m., 1 hour 53 minutes after it on the 1st; on the 15th it rises at 6.47 a.m., 1 hour 29 minutes after the Sun, and sets at 8.9 p m., 2 hours 11 minutes after it.

Mars rises at 3.57 a.m., 1 hour 36 minutes before the Sun and sets at 3.13 p.m., 2 hours 38 minutes before it on the 1st; on the 15th it rises at 3.29 a.m., 1 hour 49 minutes before the Sun and sets at 2.55 p m., 3 hours 3 minutes before it.

Jupiter rises at 9.31 a.m. and sets at 11.15 p.m. on the 1st; on the 15th it rises at 8.46 a.m. and sets at 10.28 p.m

Saturn rises at 4.14 p.m. and sets at 4.50 a.m. on the 1st; on the 15th it rises at 3.16 p.m. and sets at 3.52 a.m.

The Southern Cross will be at its greatest western elongation, position III. as on the clock-face about 6 p.m. on the 1st October. It will reach position IV. about 8 p.m. and disappear at Warwick about 10 p.m. reaching the Southern meridian about midnight.

6 Nov.	☽	Last Quarter	11	28 p.m.
14 ,,	●	New Moon	2	42 p.m.
22 ,,	☾	First Quarter	11	19 a.m.
29 ,,	○	Full Moon	2	12 a.m.

Apogee, 12th November, at 7.48 p.m.
Perigee 28th November, at 12.24 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

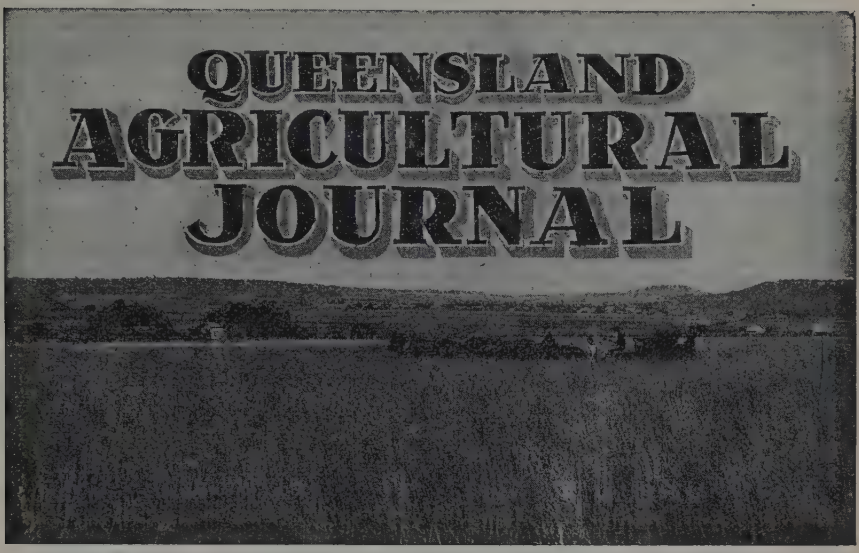
The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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VOL. XLVI. 1 NOVEMBER, 1936. PART 5

Event and Comment

A Record of Agricultural Progress.

MATTERS of outstanding importance are dealt with in the Annual Report of the Under Secretary and Director of Marketing, Mr. E. Graham, to the Minister for Agriculture and Stock, Hon. Frank W. Bulcock. In the course of a comprehensive survey of agricultural facts and tendencies, Mr. Graham said:—There is scarcely any phase of farming to which departmental influence does not extend, to the advantage of the man on the land. While the Department continues perseveringly in its enormous task, success would be unattainable without the goodwill and co-operation of the farmers themselves. On them devolves the practical side of the business, the application of preventive, corrective, or ameliorative measures evolved or recommended by the Department, and the necessity of close collaboration with administrative, scientific, and technical staffs. Obviously, in dealing with the problems of primary industry little could be done without the farmers' cheerful and practical co-operation.

Another important chapter in the history of agriculture in Queensland was opened by the initiation in January last of a scheme of co-ordinated scientific research. Professor E. J. Goddard, B.A., D.Sc., Dean of the Faculty of Agriculture and Professor of Biology in the University of Queensland, was appointed Science Co-ordinating Officer temporarily to assist in implementing the scheme. The general principle is a recognition of the fact that conditions in agriculture influence largely the level of prosperity in industries dependent on it. Consideration is being given to several of the major problems with which

primary industry in Queensland is faced to-day. Among them is the problem of soil erosion, a matter of vital importance to both farmers and graziers. To loss of soil must also be added deterioration of pastures and denudation of catchment areas as parts of the general problem.

Overstocking and wrong pasture management—in some cases an entire lack of management—are taking toll of our valuable indigenous grasses, herbage, edible shrubs, and trees. This fact emphasises the necessity of the maintenance of a balance between carrying capacity and number of stock depastured on grazing areas, and of which the favourable season should not be the sole criterion. Cognisance of these matters is essential in any system of scientific research, and the Department will, it is believed, achieve practical results through the co-ordination of its services, which implies an essential liaison with other bodies working towards the solution of pressing national problems. There are, obviously, certain fundamental facts and principles involved which can only be considered fully under a system of co-ordinated research. In fact, all departmental activities—field work, control of plant and animal diseases, regulatory administration and general agricultural economy—are but an expression of scientific research.

During the year close attention was given to pasture improvement based largely on fundamental research involving two important purposes—the testing of indigenous and introduced grasses and demonstrating practically the best methods of treatment and propagation. Other matters dealt with in this connection included proper subdivision of grazing areas, systematic grazing and the prevention of overstocking, and, incidentally, adequate and protected water supplies.

It is pleasing to report that farmers have evinced a keen interest in all these and related projects.

Within the realm of agricultural economics much was accomplished by the Department in the course of the year. Organised marketing has occupied a prominent place amongst its many activities, especially since the inception of the Marketing Branch. By a diversity of methods, legislative and otherwise, it has endeavoured to ensure that the producer receives the best possible price for his products. Fundamentally, however, the improvement of the marketing system rests with the primary producers themselves. The Department may devise enabling machinery and give the necessary direction, but it is really a matter for the farmers themselves, acting collectively, through their local producers' organisations, to work out their own economic salvation.

It is easier to talk of new and better markets than to capture or establish them. Further effort must be made to improve the quality of our export products so that, whatever competition we may have to encounter on oversea markets, we shall at least hold our own on point of intrinsic quality.

The marketing side of the agricultural industry is still beset with problems both vast and intricate, and any shortcomings in our export trade must be eliminated by the closest co-operation of all concerned.

In the course of the year a system of periodical staff talks, under the presidency of the Honourable the Minister, was inaugurated. As a means of interchanging ideas, co-ordinating services, and stimulating thought and action, the regular assembly of heads of branches has been productive of much benefit in departmental administration, and has been entirely successful generally.

Development of Export Trade in Farm Products.

DISCUSSING the marketing situation generally, Mr. Graham remarked:—It is gratifying to pool boards, particularly boards that engage in the export trade in primary products, to know that the Premier (Hon. W. Forgan Smith, LL.D.), during his visits to Great Britain, had made opportunity for an examination of the conditions under which Queensland products are marketed overseas.

As a result of the survey of the marketing conditions that was made by the Honourable the Premier, pool boards have been furnished with valuable information and advice that will be of very material benefit and guidance to the marketing organisations concerned in the conduct of their functions.

The Premier ascertained that the quality of our products, particularly the produce that was up to the standard of our highest grade classification, and the manner in which the product had been prepared and presented for market, met with the general approval of those trading in the produce. The Premier was assured of and greatly impressed by the necessity for pool boards to give increased attention to the utilisation of British ports other than London. It is common knowledge that both on the eastern and western British coasts there is a number of first-class ports which serve large industrial and manufacturing centres of England and Scotland. These ports are used for the intake of the major portion of the foodstuffs required to meet the needs of a population several times greater than that of the Commonwealth. These cities and large towns provide potential avenues for trade in our products, but the trade is not to be captured without some initial effort on the part of the exporters. The fuller utilisation of these ports would be at least a gesture that would contribute towards the annexation of a fair proportion of the trade which, for the greater part, is being enjoyed at present by other countries that consign butter, cheese, eggs, and meat (principally pork) to Britain.

It is the case that the ports outside of London are being used to an increased extent each year, but it is highly desirable that the volume of the trade should be augmented considerably. The evidence is that we are producing products of the kind and quality suitable for the trade, and the consumers there are favourably disposed towards Australian produce, with a bias towards foodstuffs produced in Queensland.

As a result of the experience that has been gained by the application of the principle of collective marketing to primary products, it can confidently be claimed that the system of collective marketing has proved to be of very material benefit to the primary producers concerned. It has created a stability in marketing operations that otherwise would be lacking. Collective marketing has made possible the expansion of many of our agricultural industries, and generally orderly marketing has rendered it possible to mould a marketing programme, and in other ways assist the growers in a manner that could not have been achieved by individual effort. There are many instances where the volume of production in pre-pool days has, since the inception of pooling, been increased manifold.

There are, however, indications that, although pools have met with a very considerable degree of success, the value of pools has not yet been fully exploited.

The Queensland Pine Beetle and Its Control.*

A. R. BRIMBLECOMBE, B.Sc., Assistant to Entomologist.

THE Queensland pine beetle* is a pest of major importance to house-owners in South-eastern Queensland. Its damage is confined almost entirely to hoop pine, and records of its occurrence have been obtained only in buildings which have been erected a number of years. Attack in dwellings usually commences on the under surface of flooring boards, from which subsequent generations spread to other parts of the building.

Nature of Damage and Timbers Attacked.

Damaged timber externally reveals numerous small circular holes (Plate 257; fig. 5) one-twentieth of an inch in diameter. These are emergence holes made by the mature beetles in liberating themselves from the wood. Internally, the wood reveals meandering tunnels (Plate 257; fig. 5) of various sizes filled with frass. Heavily damaged timber may very well be compared with sponge rubber, and can be crumbled away by the hand.

The emergence holes are usually the first external signs that borers have been at work. However, their presence indicates that the damage caused by these particular individuals has already been completed. Eventually the timber is so extensively riddled that it retains little, if any, structural strength, but this is the case only if it is subjected to repeated infestation, a development which readily occurs. Often it is not till this state is reached, followed by collapse of the wood, that damage is found, as instanced in flooring.

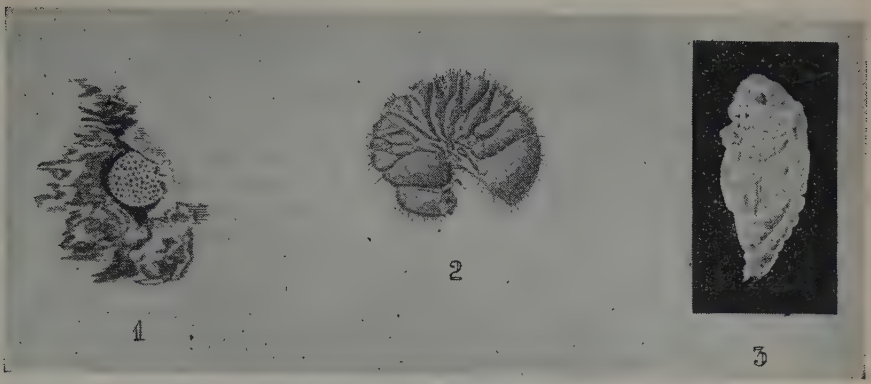
Queensland hoop pine timber is the natural food of the borer. However, there is one other timber, New Zealand white pine, which in one instance only has been found attacked.

In all cases of recorded damage, the timber was of some considerable age, but at the time it was noticed, the damage was also of some age. Consequently, it is difficult to say how soon after felling of the timber or erection of the building attack is likely to occur. From evidence to date, it sems reasonable to state that attack will not take place for some few years after felling.

Life History and Habits.

The female beetles when commencing an attack lay their eggs in cracks in boards or between boards or on undressed surfaces. Subsequent generations choose similar positions or return to the emergence holes. The minute white globular egg (Plate 257; fig. 1) is just discernible to the naked eye. After a period of a few weeks it hatches into a small white curved larva or grub (Plate 257; fig. 2) which immediately tunnels into the wood. The grubs do all the damage. They tunnel backwards and forwards through the wood, month after month, extracting nourishment from the digestible parts in the chewed material. How long these grubs continue to tunnel is not exactly known, but it must be about two years. When fully grown, each grub seals the tunnel with a transverse wall so as to form an oval chamber in which it changes into a pupa (Plate 257; fig. 3). This is a resting stage which after a few weeks completely transforms into the sexually mature beetle (Plate 257;

* *Calymmaderus incisus* Lea, subfamily Anobiinæ, family Ptinidæ.





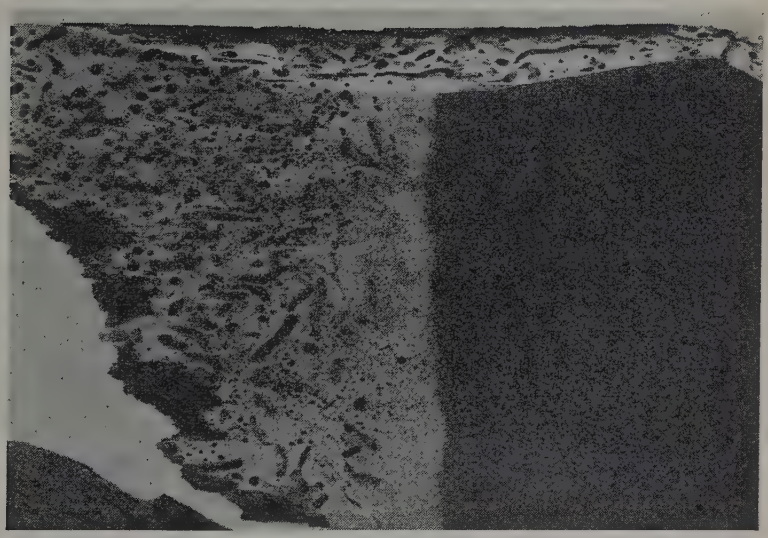


Plate 257.

THE QUEENSLAND PINE BEETLE (*Calymmaderus incisus* Lea).

Fig. 1.—Egg *in situ* × 24. Fig. 3.—Pupa × 8.
Fig. 2.—Larva × 8. Fig. 4.—Adult × 15.
Fig. 5.—Hoop pine showing internal damage and exit holes.

fig. 4), one-tenth of an inch long, which does no boring except to eat its way to the exterior, so that it can be free for mating and subsequent egg-laying.

Distribution in Queensland.

As its name indicates, this insect is a native of Queensland, and so far there has not appeared any record of its occurrence elsewhere. Its range as at present determined is comparatively small, covering a narrow strip of the south-eastern portion of the State, extending northwards to Maryborough and inland to Ipswich. However, within these limits, the concentration of the insect and its attack is of some considerable magnitude, more particularly in closely-built areas. Every suburb of Brisbane has shared in the records of damage, as also have almost every seaside resort and agricultural centre near the coast south of Maryborough. House to house dispersal of attack is attributed to the beetles which can fly readily, but in spanning great distances, probably they are assisted by winds. Dissemination by transport of infested material has been recorded, but is not of frequent occurrence.

Prevention of Infestation.

Absolute prevention of attack is possible only by completely covering the pine with paint or other suitable material or impregnating it with chemicals which will kill the young grubs immediately on hatching from the eggs. At present the onus of preventing infestation rests with the house-owner, whose best method is to completely cover all exposed pine surfaces with paint or other material, preferably at the time of erection or as soon after as possible, paying particular attention to the spaces between boards. This eliminates suitable sites for egg-laying, and might be cheaper than later repairs and treatment of attacked timber. Where there are surfaces which cannot conveniently be painted, e.g., hidden surfaces of lining boards, any possible entrance of the beetles should be blocked with material other than pine or with treated pine. As pine floors seem to be the most liable to attack, adequately desapped and seasoned hardwood could be substituted, and this is as cheap as or cheaper than pine.

Methods of Arresting Damage.

Borer control is not a simple matter, and often demands perseverance. Any one treatment will not give complete control, therefore repeated treatments are necessary. The grubs of the Queensland pine beetle are usually well entrenched within the wood, but when about to pupate, they come comparatively near the surface. This occurs in spring and summer, so during these periods best results are obtained from attempts at control. The first treatment should be made in early spring, followed by at least one other treatment in the summer. A careful watch will then be required, and treatments repeated in successive seasons until the attack is arrested.

Treating infested timber involves brushing and injecting or spraying and injecting some liquid which will penetrate the wood and kill the insects by contact, suffocation, or poisoning. Several suitable products are already on the market or can easily be prepared, and several firms handling these materials hire out the apparatus necessary for the application of the treatments.

When attack has been located all infested boards should be tested by hitting them with a mallet. Any that collapse under the blow should

be removed and burnt. Replacements and lightly-infested wood may be treated with one or other of the liquids mentioned below.

Heavy grade creosote is the most effective for general application. It possesses fair penetrative power and evolves a good concentration of fumes. It is not recommended for use within the building since it causes a dark flat stain which usually is not desired, and the success of subsequent coats of paint, polish, &c., might be impaired. It is most suitable for the under surface of floors and the hidden surface of linings, for which purpose some weather boards must be removed temporarily.

This creosote can be diluted with kerosene to reduce the amount of stain produced, an effective mixture being equal parts of each. A dilution of one part of creosote to eight of kerosene leaves only a faint stain, and later a paint or varnish finish is possible. A light grade creosote of clear colour does not leave a stain, and, though it might not be so effective as the heavy grade, it might meet requirements in certain cases.

Heavy grade creosote can also be applied as an emulsion prepared by adding one part of 5 per cent. soft soap solution in water to four parts of creosote, followed by thorough stirring to ensure complete and even dispersal of the creosote throughout the mixture.

A suitable mixture for use within the building is one pound of paradichlorobenzene dissolved in one gallon of kerosene. Kerosene or turpentine alone may be used; however, it has been stated that a mixture containing equal parts of each possesses better penetrative power than either alone. None of these liquids leave any stain.

On an average, one gallon of liquid is sufficient for 150 square feet of timber. Brushing is the most general method adopted. Spraying might be more convenient and quicker, provided the instrument is equipped with a nozzle that does not produce splashing or a mist so fine that there is little adherence of the liquid to the wood. The most satisfactory method is to inject the liquid by a syringe pump into the emergence holes, followed by brushing or spraying.

WHAT IS AN ACRE?

5 yards by 968 yards	contains	1 acre.
10 yards by 484 yards	„	1 acre.
20 yards by 242 yards	„	1 acre.
40 yards by 121 yards	„	1 acre.
80 yards by 60½ yards	„	1 acre.
70 yards by 68 1.9 yards	„	1 acre.
220 feet by 198 feet	„	1 acre.
440 feet by 99 feet	„	1 acre.
110 feet by 369 feet	„	1 acre.
60 feet by 726 feet	„	1 acre.
120 feet by 363 feet	„	1 acre.
240 feet by 180½ feet	„	1 acre.

Studies on the Biology and Control of the Large Roundworm of Fowls, Ascaridia galli (Schrank 1788) Freeborn 1923.

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PART V.

6. THE CONTROL OF ASCARIDIA GALLI.

1. THERAPEUSIS.

INVESTIGATIONS into the therapeusis of ascaridiasis have followed two lines (*a*) individual treatment, in which each individual bird is given a vermifuge, and (*b*) flock treatment, in which a number of birds are treated simultaneously by means of a vermifuge, which is mixed with the mash. Greater success is claimed for individual administration, for this method ensures that each bird receives the full dosage. Flock treatment as originated by Herms and Beach[65] is apparently not as successful in the field as it is under laboratory conditions. This is probably due to the fact that the efficiency of this method of treatment depends solely upon food consumption—a factor very difficult to control among birds in the field Herms and Beach[65], for example, when recommending an infusion of chopped tobacco stems in the mash, point out that care should be taken to see that each bird receives its share. Freeborn[53], who found that a mixture of tobacco dust in the mash gave very satisfactory results under laboratory conditions, noted that these results were not always repeated in the field, one of the reasons being that the treated mash was distasteful to many birds. An impaired appetite, moreover, frequently accompanies an advanced helminth infestation, and under such conditions, the efficiency to be expected from a flock treatment would be rather low. Such inability to control the intake of food by each bird would also be likely to prove dangerous, especially in the case of such drugs as are employed for a flock treatment administered once only.

Individual treatment also apparently has its disadvantages, as it has been shown that the treated birds may become so affected by a vermifuge that their vitality and egg production may be lowered. Atwood and Clark[24] first drew attention to these ill-effects as a sequence to individual treatment. Hall and Shillinger[61], however, reported that in a field trial, which they carried out on 16 pullets given carbontetrachloride at the rate of 2·27 ml. per kilo. no deleterious effects on egg production were noticed by them. This observation is supported by Stafseth and Thomson[98], who concluded from their field trials with "Iodin Vermicide" that birds, used to being handled, frequently failed to show any noticeable reduction in egg yield, and usually show a marked improvement in condition.

On the other hand, work by Bleecker and Smith[34 to 37] on the use of vermifuges under field conditions was reported as indicating that the repeated use of an individual treatment vermifuge on pullets ranging on infested soil was of no advantage in increasing egg production or in improving the health and vigor of the birds. In one experiment[35], however it was found that although the rate of egg production of treated birds may be very uneven, due to a marked decrease following treatment, the number of eggs per treated bird over a season may be greater than the number produced per untreated birds.

Thomas[100], using tetrachlorethylene plus kamala and "Iodin Vermicide," found that there was a marked decrease in egg production following treatment, and that, thereafter, the production of the treated birds did not at any time equal that of the untreated birds. There was also a higher mortality rate among the treated birds, whose food consumption per dozen eggs was also greater. Thomas concluded that treatment was valueless, because birds on infested soil became rapidly reinfested owing to the ill-effects of the vermifuge upon their vitality.

Maw[74] has recorded that the use of kamala may seriously affect egg production and finally, Ackert and Graham[22], using carbontetrachloride at the rate of 4ml. per kilo, have noted that with two treatments with an interval of three weeks, the egg production of ten treated birds decreased from 62.38 per cent. to 52.38 per cent. over a six weeks' period, while the production of ten untreated birds increased from 50.48 per cent. to 70.48 per cent. over the same period.

In the following series of trials both individual and flock treatment have been considered. Although flock treatment has received scant attention from poultry helminthologists during recent years, its inclusion in this series of experiments was considered warranted for two main reasons:—

(*a*) The majority of poultry farmers in Queensland will not employ individual treatment, owing to the time, labour, and expense involved. If, therefore, a flock treatment, simple in its application, could be made available, even though its efficiency were only moderate, its regular use by these people would, in all probability, be followed by an improvement in health of the poultry they control.

(*b*) It is possible that a flock treatment, in which treatment is applied over a number of days, so that the amount of a vermifuge consumed per day is relatively small, may not be followed by the ill-effects on egg production, &c., which have been reported by several investigators as a sequence to individual treatment.

1. INDIVIDUAL TREATMENT.

(i.) Resumé of Previous Investigations.

The principal drugs employed in the individual treatment of poultry infested with *A. galli* are (1) a solution of nicotine sulphate (40 per cent. nicotine), (2) iodine, which is used very largely in the United States as "Iodin Vermicide," (3) tetrachlorethylene, and (4) carbontetrachloride. Other drugs which have ben critically tested include oil of chenopodium, oil of turpentine, copper sulphate, pyrethrum, derris, kamala, normal butilydene-chloride, benzine, and a few others of minor importance only, such as oil of eucalyptus, arecoline, and oil of aniseed. Some of these have given relatively high efficiencies, and others have proved to be of no value whatsoever.

Nicotine Sulphate and Its Compounds.

The use of nicotine sulphate (40 per cent nicotine) as an anthelmintic for *A. galli* was first investigated by Freeborn[52]. Previously, flock treatments employing the admixture with the mash of an infusion of chopped-up tobacco stems (Herms and Beach[65]) and of commercial

tobacco dust (Doughterty and Beach[48]) and (Freeborn[51]) had given satisfactory laboratory trials and were in use in the field. Freeborn[52], however, found that flock treatment with tobacco dust was not always reliable under field conditions, and, as a result, commenced experiments with Blackleaf 40—a proprietary nicotine sulphate solution containing 40 per cent. nicotine. His work showed that this extract, if given in sufficient quantities to be efficient, was decidedly toxic. Subsequently, however, Freeborn found that when the extract was mixed with Lloyd's alkaloidal reagent, a special type of Fuller's earth, high efficiencies, namely 97.2 per cent., could be secured against *A. galli*, and, moreover, that the inclusion of this reagent protected the birds from any toxic action of the nicotine sulphate. The formula recommended consisted of 6.6 ml. (7.92 gms.) of Blackleaf 40, and 16 gms. of Lloyd's reagent. The dosage was given as 350 mgms. to 400 mgms. of this mixture, which, Freeborn stated should be given without any previous starvation, and is well tolerated by birds as young as eight to ten weeks.

Carpenter[39], using nicotine caseinate, reported that this derivative was 99 per cent. effective and non-toxic. In the annual report, 1923-24, the Missouri Poultry Station[85] state that good results were secured by them with a 4 ml. dose of a 4 per cent. solution of nicotine sulphate in mineral oil.

Extensive investigations into the use of nicotine sulphate as a poultry vermifuge, including several proprietary preparations, were reported by Bleecker and Smith in 1933[34,35,36]. These workers found Freeborn's formula highly effective, but when given with 15 grs. kamala as a "double duty" treatment, the efficiency was somewhat reduced, being 72.5 per cent. in the 32 birds so treated. Nicotine sulphate (Blackleaf 40) in doses of 2.5 minims to .3 ml. plus 15 grs. kamala was 65.7 per cent. effective in 135 birds against all helminths, excluding *Heterakis gallinæ*. Doses of nicotine sulphate up to 1 ml. were employed, and it was reported that although as much as ten drops could be given with safety to large cocks and five drops to grown hens, the efficiency of the drug was decreased, and its toxicity increased if doses larger than .3 ml. were employed. Bleecker and Smith[34] considered nicotine sulphate in 2.5 minim to .3 ml. doses effective and reasonably safe, except for badly depressed birds, but after further trials[35] they reached the conclusion that "Whilst Blackleaf 40 appeared to be an effective vermifuge, its depressing action on producing birds and the fact that toxic symptoms follow its use in some birds, makes it of questionable value, and, therefore, it cannot be highly recommended."

In recent work in Russia, Skriabine and Schultz[96] noted that of the several drugs tested by them, nicotine sulphate was most satisfactory.

Carbontetrachloride.

In 1923, Hall and Schillinger[61] reported that this drug was highly effective against *A. galli*. The doses used ranged from 1 ml. to 20 ml. per kilo, and while a dose of 1 ml. per kilo failed to remove any worms from the one bird to which it was administered, doses of 2 ml., 4 ml., and 5 ml. per kilo. were 100 per cent. effective in each case in which they were employed. Their report does not indicate any toxicity, even from the dose of 20 ml. per kilo. Graybill and Beach[57] noted that a 2 ml. dose to adult birds in hard capsules was 98 per cent. effective. Freeborn, however, was unable to report satisfactory results from the doses employed by him. Graham and Ackert[54] found that a dose of 4 ml. per kilo.

would remove all *A. galli*.. No toxic symptoms followed this dose rate, but a dose of 10 ml. per kilo. was reported to be decidedly toxic. These trials were repeated in 1935[22], and it was found that whilst doses of 8 ml. and 10 ml. per kilo. were effective but toxic, a dose of 4 ml. per kilo., while removing all the worms, had only transitory effects. A field trial with this dose rate to ten laying pullets showed, however, that inactivity and diarrhœa may be present for two days subsequent to treatment.

Von Mocsy[76] did not find carbontetrachloride very satisfactory, and Skriabine and Schultz[96] reported that whilst the drug gave good results in their hands, it was not as effective as nicotine sulphate or tetrachlorethylene.

Tetrachlorethylene.

Schlingman[89] first tested tetrachlorethylene against *A. galli* and reported that a dose of 1 ml. was highly effective in birds up to 2 lb. 12 oz. in weight. When used in conjunction with kamala[91], its efficiency was reduced, but Schlingman considered that this would not have occurred if a three days' interval had been present between the use of the two drugs.

In 1929, further tests were carried out by this worker[92], and he found that doses less than 1 ml. were not particularly effective in birds up to 2 lb. in weight, and that even at this dose rate, the drug was not always reliable in its action. With Guzhit[93] Schlingman found that no toxicity followed doses of 1 ml. to 5 ml. to chickens ·91 kilogrammes to 1.6 kilogrammes in weight or following a dose rate of .83 ml. per kilo.

Ackert and Graham[22], comparing the toxicity of tetrachlorethylene and carbontetrachloride, found the former more toxic, for whereas a dose of 6 ml. per kilo. of carbotetrachloride produced transitory effects only, due principally to inhalation intoxication, tetrachlorethylene, given at a similar dose rate, caused visible toxic symptoms for five days subsequent to its administration. Skriabine and Schultz[96] mention tetrachlorethylene as being very effective.

Iodine.

The use of iodine as a vermifuge for poultry was first investigated by Chandler[40, 41]. He found an iodine suspensoid which was claimed to be not only highly effective against both roundworms and tapeworms, but also lethal to their eggs. This preparation is known in the United States as "Iodin Vermicide." Stafseth and Thomson[98] reported a 100 per cent. efficiency in 29 birds against *A. galli* from this compound, which was also noted to be entirely harmless. In field trials, they found that repeated treatments were followed by an improvement in health and rate of production. Bleecker and Smith[34] recommend "Iodin Vermicide" as being effective, and particularly safe for badly-depressed birds. The adult dose is 1 fluid oz., and the efficiency depends entirely upon delivering the preparation directly into the gizzard, for which purpose a special bulb syringe fitted with a long slender nozzle is provided.

Von Mocsy[76] reported an organic compound of iodine, the glycerine ester of 9-10-di-iodo-12-oxy-octadecylic acid to be safe and 100 per cent. effective.

Other Drugs.

Copper Sulphate.—The Missouri Poultry Station[85] noted that a 1 gram dose of copper sulphate was 78 per cent. effective in adult birds. Von Mocsy[76], however, reported that this drug used either as a powder or in solution did not give very satisfactory results.

Oil of Turpentine.—Hall and Foster[60] tested oil of turpentine on six chickens, ·45 kilogramme to ·9 kilogramme in weight. The birds were given 2 ml. of the drug in 2 ml. of olive oil, which dosage was followed by 8 ml. of castor oil. An efficiency of 76 per cent. was obtained. These results were confirmed by the Missouri Poultry Station[85]. Von Moèsy[76], however, was unable to report satisfactory results from his tests with this drug.

Pyrethrum.—In 1934, Rebrassier[82] reported that a 200 mgr. dose of a sample of pyrethrum containing ·8 per cent. pyrethrin I. removed 95 per cent. of the Ascaridia from 30 birds.

The allied drug, derris, was used by Freeborn[51], who was unable to obtain any degree of efficiency with the dosages employed.

Normal Butilydene Chloride.—This drug was used by Wright et. al. [101]. Their report indicated that doses of 2 ml. to 6 ml. were well tolerated and 100 per cent. efficient. A dose of 1 ml., whilst not so effective, gave very satisfactory results.

Benzine, arecolin, oil of eucalyptus, and kamala have also been tested by Von Moèsy[76], but were all regarded as unsatisfactory.

(ii.) Laboratory Experiments.

In the laboratory trials reported herein, the various drugs selected were first tested on young birds. These birds were secured as day old chickens and infested with *A. galli* when one month old, treatment experiments being commenced several weeks later, by which time the majority of the worms had reached maturity, and were of a conspicuous size. The breed employed was Single Comb White Leghorns.

Owing to insufficient accommodation it was not possible to carry out trials involving single subjects and groups of birds of from three to twelve in number were employed.

Previous work by the writer on the life history and pathogenicity of *A. galli* had shown that it was very rare for chickens when given a single small dose of eggs at 30 days old to be, after a few weeks infestation, entirely worm-free. The chickens used in these tests were given single doses of 100 eggs to 200 eggs, and it is considered reasonably safe to assume, therefore, that the drug employed had been 100 per cent. effective in those birds in any group in which no worms were found after treatment.

With each series of experiments carried out with these young birds a group of control untreated birds was always maintained. In this way the possibility of the expulsion of worms by the treated birds being due to factors other than treatment was guarded against. The number of worms passed by the control groups during any critical test was never more than three, which number, it is considered, is too small to have any significant effect upon the efficiencies obtained.

The drug giving the most promising results among the young birds was then tested on adult birds—hens one to two years old. In the case of the adult birds, it was possible to obtain the efficiency of the drug in each individual bird. Controls were not maintained in this series of trials, as the adult birds varied in age and came from different poultry farms.

In all cases the birds were placed on wire-mesh floors and the droppings were collected on iron trays beneath. The majority of the

worms voided were collected during the first twenty-four hours. Very few were passed on the second and third days, and it was extremely rare to find voided worms on the fourth day.

The drugs tested included nicotine sulphate, carbontetrachloride, tetrachlorethylene, oil of chenopodium, oil of turpentine, pyrethrum, copper sulphate, and carbonbisulphide, all of which, with the exception of carbonbisulphide, have been employed by other investigators and noted as being reasonably or highly efficient. It is regretted that "Iodin Vermicide" was omitted from these trials, but this preparation is not obtainable in Queensland.

Nicotine Sulphate.

Prior to its use in the tests described below, the sample of nicotine sulphate used was analysed and found to contain 40·8 per cent. nicotine. The results obtained are summarised in Table XIX.

TABLE XIX.

RESULTS FROM NICOTINE SULPHATE.

No. of Experiment.	No. Birds Used.	Weights of Birds.	Dosage.	No. Worms Passed.	No. Worms Remaining in Individual Birds.	Total Worms Remaining.	Per cent. Efficiency.
		Oz.	Minims.				
1	10	18–24	1·5	37	5, 1, 7, 14, 2, 0, 0, 0, 0, 0	29	56·0 } 55·4
2	10	21–26	1·5	35	2, 6, 7, 3, 7, 4, 0, 0, 0, 0	29	54·7 }
3 *	5	15–19	2·0	18	2, 3, 8, 0	13	58·0
4	5	17–21	2·5	15	4, 9, 1, 7, 4	25	37·5
5	12	16–23	‡ 250 mgm.	15	1, 8, 3, 16, 1, 4, 7, 1, 4, 0, 0, 0	45	25·0
6 †	5	18–28	‡ 350 mgm.	24	5, 8, 7, 7, 9	36	40·0

* 1 bird died shortly after treatment. † No starvation. ‡ Freeborn's formula.

Discussion.

All birds except those in experiment 6, which were unstarved, were starved for approximately 17 hours before and for 3 hours after treatment, the drug in all cases being administered in hard gelatine capsules.

In experiments 1 to 4 inclusive, all birds displayed symptoms of toxicity, drowsiness, a staggering gait, and prostration following shortly after administration, being very marked in the case of the larger doses. Where 2·5 minims were used, the birds did not recover completely till about 24 hours after treatment. Of the five birds given a 2 minim dose, one collapsed and died within thirty minutes.

The highest efficiency was secured from a 2 minim dose, which removed 58 per cent. of the worms from four birds, from one of which no worms were collected on autopsy (Exp. 3). A 1·5 minim dose to 20 birds (Exps. 1 and 2) was apparently 100 per cent. effective in nine birds, but left a sufficiently large number in the remaining eleven to reduce the efficiency of this dosage to 55.4 per cent. The highest dosage employed, namely 2.5 minims, was less effective than either of the two smaller doses, and gave an efficiency of only 37.5 per cent (Exp. 4).

In Experiments 5 and 6, where a 250 mgm. and a 350 mgm. dosage of Freeborns' formula were employed, it was evident that the addition of

the Lloyd's reagent was successful in protecting the birds from the toxic action of the nicotine sulphate. With the exception of two of the birds given 250 mgm. (Exp. 5) no symptoms of toxicity were observed, and in these two birds only very slight evidence of toxicity was manifested. In the twelve birds subjected to seventeen hours' starvation before and three hours' starvation after the administration of a 250 mgm. dose (Exp. 5) the dosage appeared to have been 100 per cent effective in only three birds, giving a total efficiency of only 25 per cent. The 350 mgm. dose was given without any starvation to five birds, but was only 40 per cent. effective (Exp. 6).

These results are not in agreement with those claimed by other workers in whose hands a nicotine sulphate solution containing 40 per cent. nicotine has given evidence of relatively* high efficiencies. The optimum dosage as noted by the writer to birds 15 oz. to 26 oz. in weight is in the vicinity of 2 minims, and apparently dosages greater than this are not only more toxic, but also less effective. Whilst previous starvation may have increased the toxicity, there is no evidence that such preparation is responsible for a decreased efficiency. A 1·5 minim dose removed 55·4 per cent of the worms present in birds previously starved for seventeen hours, whilst 350 mgr. of Freeborn's formula, which contains approximately 1.6 minims of nicotine sulphate, given without starvation, was only 40 per cent. effective. From these tests it must be concluded that nicotine sulphate was in the writer's hands both ineffective and dangerous.

Tetrachlorethylene.

The results obtained with this drug are set out below in Table XX.

TABLE XX.

RESULTS FROM TETRACHLORETHYLENE.

No. of Experiment.	No. Birds Used.	Weights of Birds.	Dosage.	No. Worms Passed.	No. Worms Remaining in Individual Birds.	Total Worms Remaining.	Per cent. Efficiency.
7	10	Oz. 18-24	·5 ml.	31	3, 1, 2, 2, 23, 1, 0, 0, 0, 0	32	49·2
8	5	16-20	·5 ml.	44	2, 2, 3, 0, 0	7	86·2
9	10	16-29	·75 ml.	74	2, 2, 2, 18, 0, 0, 0, 0, 0, 0	24	75·5
10	10	17-27	1 ml.	77	31, 8, 2, 0, 0, 0, 0, 0, 0, 0	41	65·2

Discussion.

All birds were starved for seventeen hours before and for three hours after treatment, the drug being administered in hard gelatine capsules.

In the first test, a ·5 ml. dose was given to ten birds, varying in weight from 18 oz. to 24 oz. A total of thirty-one worms was passed, and on post mortem it appeared as though this dosage had been 100 per cent effective in four birds, and highly effective in five others. From the tenth bird, however, twenty-three worms were collected,

* NOTE.—The writer's experience with the therapeusis of Ascaridiasis has led him to consider that worms may be more readily removed from old grown birds than from young birds. As most of the tests by other investigators with nicotine sulphate have, so far as it can be determined, been carried out on grown birds, it is possible that this factor may have been responsible for the poor results secured with this drug in these investigations.

this number thereby considerably reducing the efficiency of the dosage in this experiment, only 49·2 per cent of the total number of worms present being removed. In the second trial with a ·5 ml. dose on five birds, somewhat lighter in weight, better results were secured, and an efficiency of 86·2 per cent. was obtained.

When the dose was increased to ·72 ml. to ten birds, 16 oz. to 29 oz. in weight (Exp. 9), autopsies showed a very high efficiency in nine birds, being apparently 100 per cent. in six of these, but the presence of eighteen worms in the remaining bird was responsible for a decrease in the efficiency of this dosage to 75.5 per cent.

A 1 ml. dose to ten birds of about the same weight as those to which a ·75 ml. dose had been administered (Exp. 10), proved to be less effective than the ·75 ml. dose. This was due to the fact that although the 1 ml. dose had apparently been 100 per cent. effective in seven birds and highly effective in the eighth bird, it failed to remove the bigger proportion of the infestations from the remaining two birds, especially from one of these from which thirty-one worms were collected, giving an efficiency for this group of only 65·2 per cent.

No symptoms were at any time observed as might be associated with a toxicity from these dosages, except in the case of one bird in the group given a 1 ml. dose, which was slightly depressed for a few hours after treatment.

The results secured with this drug are rather better than are indicated in the accompanying table. In the majority of the birds the dose employed gave relatively high efficiencies, but as in some birds it appeared to be without any effect on the infestation, it was concluded that the drug was unreliable in its action, and no further trials were carried out.

Oil of Chenopodium.

The oil of chenopodium employed was from a sample sold by W. J. Bush and Co., London. The results secured in these tests against *Ascaridia galli* are given in Table XXI.

TABLE XXI.

RESULTS FROM OIL OF CHENOPODIUM.

No. of Experiment.	No. Birds Used.	Weights of Birds.	Dosage.	No. Worms Passed.	No. Worms Remaining in Individual Birds.	Total Worms Remaining.	Per cent. Efficiency.
		Oz.					
11	10	19–26	·15 ml. + 2 ml. castor oil	52	5, 1, 2, 0, 0, 0, 0, 0, 0, 0	8	86·6
12	9	18–24	·2 ml. + 2 ml. castor oil	87	3, 4, 3, 4, 0, 0, 0, 0, 0 ..	14	86·1
13	5	20–26	·3 ml. + 3 ml. castor oil	54	1, 3, 2, 2, 0	8	87·1
14	5	26–29	·4 ml. + 3 ml. castor oil	45	3, 0, 0, 0, 0 *	3*	100·0

* One bird died within 24 hours after treatment and contained three worms. This dosage was therefore 100 per cent. effective in the remaining four birds.

Discussion.

The dosages of oil of chenopodium were given in hard gelatine capsules, followed immediately by the castor oil. The birds were starved for seventeen hours before and for three hours after treatment.

In the first test (Exp. 11) a ·15 ml. dose of oil of chenopodium, followed by 2 ml. of castor oil was employed, the ten birds receiving this dose weighing from 19 oz. to 26 oz. Fifty-two worms were passed, and on post mortem no worms were found in seven of the birds, and five, one, and two respectively in the remaining three—an efficiency of 86·6 per cent. No ill-effects from this dosage were observed in any bird.

When the dosage was increased to ·2 ml. to birds of somewhat the same weight, 86·1 per cent. of the worms present was removed. One bird was apparently affected by this dosage and did not recover completely for about two days (Exp. 12).

A ·3 ml. dose followed by 3 ml. of castor oil, removed fifty-four worms from five birds, 20 oz. to 26 oz. in weight, and left a total of eight worms, an efficiency of 87·1 per cent. One bird was markedly affected by this dosage, and in all birds the droppings were diarrhœal for about two days. (Exp. 13).

A final test with a dose of ·4 ml. of oil of chenopodium, followed by 3 ml. of castor oil to five birds, 26 oz. to 29 oz. in weight, showed this dosage to be decidedly toxic. One bird died within 24 hours, and the remaining four were affected for from four to five days. The efficiency was 100 per cent. (Exp. 14).

These trials indicate that oil of chenopodium in a dose of ·15 ml. with 2 ml. of castor oil appears to be safe and highly efficient. Increasing the dosage to ·2 ml. and ·3 ml. was not followed by any marked increase in efficiency, though there was a very definite increase in toxicity. A ·4 ml. dose was 100 per cent effective, but decidedly toxic. The birds employed for these higher dosages (Exps. 12, 13, and 14) were found on post mortem to be affected to varying degrees with an intestinal form of coccidiosis. Such a condition contraindicates the use of this drug, and it is probable that with healthy birds of the same weights there might have been little or no evidence of toxicity from the ·2 ml. to ·4 ml. doses—from the ·2 ml. and ·3 ml. doses at any rate. As, however, enteritis is a fairly common condition among poultry, it was felt that the drug could not be recommended and no further trials were therefore carried out.

Copper Sulphate.

Two tests were carried out with copper sulphate. In the first experiment eight birds were each given 1 gm. in 4 ml. of water. The birds weighed 20 oz to 26 oz. and were subjected to the usual periods of starvation. Within two hours of treatment all birds were visibly affected, and were all dead within three days.

When the dose was reduced to ·5 gm. an efficiency of 66.6 per cent. was secured from five birds of approximately the same weights. No birds died, but all were affected to varying degrees for several days after treatment.

TABLE XXII.

COPPER SULPHATE.

No. of Experiment.	No. Birds Used.	Weights of Birds.	Dosage.	No. Worms Passed.	No. Worms Remaining in Individual Birds.	Total Worms Remaining.	Per cent. Efficiency.
		Oz.					
15	8	20–26	1 gm.	35	..	..	All birds died
16	5	18–25	·5 gm.	30	5, 2, 0, 4, 4	15	66·6

Copper Sulphate and Nicotine Sulphate.

In the first experiment with this combination, a dose of ·5 gm. supper sulphate in 2 ml. of water plus 1 minim of nicotine sulphate was employed. This proved 97·5 per cent effective in eight birds, removing seventy-seven worms and leaving two. This dosage proved rather toxic however. A smaller dose of copper sulphate, namely ·2 gm., with 1 minim of nicotine sulphate was only 51·6 per cent. efficient in four birds. While a reasonable efficiency may have been secured with ·3 gm. copper sulphate, it was felt that this dose would not leave a sufficient margin of safety, and no further trials were therefore carried out.

TABLE XXIII.

COPPER SULPHATE PLUS NICOTINE SULPHATE.

No. of Experiment.	No. Birds Used.	Weights of Birds.	Dosage.	No. Worms Passed.	No. Worms Remaining in Individual Birds.	Total Worms Remaining.	Per Cent. Efficiency.
		Oz.					
17	8	19–25	·5 gm. cop. sulph., 1 min. nic. sulph.	77	1, 1, 0, 0, 0, 0, 0, 0 ..	2	97·5
18	4	21–25	·2 gm. cop. sulph., 1 min. nic. sulph.	32	7, 5, 10, 8..	30	51·6

Oil of Turpentine.

The efficiencies secured with doses of 1 ml. and 2 ml. of this drug are given in Table XXIV.

TABLE XXIV.

RESULTS FROM OIL OF TURPENTINE.

No. of Experiment.	No. Birds Used.	Weights of Birds.	Dosage.	No. Worms Passed.	No. Worms Remaining in Individual Birds.	Total Worms Remaining.	Per Cent. Efficiency.
		Oz.					
19	3	21–24	1 ml. + 2 ml. castor oil	32	14, 6, 8	28	53·3
20	5	21–27	2 ml. + 2 ml. castor oil	65	3, 2, 0, 0, 0	5	92·9

Discussion.

In both groups of birds the oil of turpentine was mixed with castor oil and the required dosage delivered into the crop by means of a syringe and rubber tube. All birds were starved for seventeen hours before and for three hours after treatment.

No ill-effects followed the use of a dose of 1 ml. oil of turpentine in 2 ml. castor oil, but the percentage of worms removed was only 53·3. Where 2 ml. of turpentine was employed two birds were definitely affected by the increased dosage, but had recovered completely by the third day. The efficiency from this dosage was very high, namely 92·9 per cent, being apparently 100 per cent. in three birds.

These two experiments indicate that whilst a 2 ml. dose to birds 21 oz. to 27 oz. in weight removed the majority of the worms, the toxic symptoms displayed by two of the five birds employed precludes its recommendation. The toxicity of this dosage may have possibly been reduced by the use of larger quantities of castor oil. However, as this,

if effective, would considerably increase the costs of the treatment, and as it did not appear as though the results secured with carbontetrachloride would be approached, no such tests were made.

Pyrethrum.

In Rebrassier's report[82] on the use of pyrethrum, a 200 mgm. dose of a sample of pyrethrum containing ·8 per cent. of pyrethrin I. gave a 95 per cent. efficiency. This dosage, therefore, contained 1·6 mgm. of pyrethrin I. The sample of pyrethrum used in the writer's test was analysed as containing only ·24 per cent. of pyrethrin I., and therefore to give a dosage of pyrethrum containing an amount of pyrethrin I. equivalent to that in the 200 mgm. dose used by Rebrassier, each of the ten birds on which the test was made was given 750 mgm. (1·8 mgm. pyrethrin I). The birds were starved for 17 hours before and for three hours after treatment, and weighed from 19 oz. to 26 oz. The results of this test (Exp.. 21) were very disappointing, as only one worm was passed, 146 being collected on autopsy.

TABLE XXV.

RESULTS FROM CARBONTETRACHLORIDE (YOUNG BIRDS).

No. of Experiment.	No. Birds Used.	Weights of Birds.	* Preparation.	Dosage.	No. Worms Passed.	No. Worms Remaining in Individual Birds.	Total Worms Remaining.	Per cent. Efficiency.
		Oz.						
23	10	18–22	*a*	·5 ml. (hard capsule)	57	2, 3, 2, 1, 1, 0, 0, 0, 0, 0	9	86·4
24	6	15–19	*a*	·5 ml. (hard capsule)	24	10, 4, 2, 0, 0, 0 ..	16	60·0
25	10	16–20	*a*	·75 ml. (hard capsule)	80	..	0	100·0
26	8	18–24	*a*	·75 ml. (hard capsule)	68	3, 7, 7, 8, 4, 0, 0, 0	29	70·1
27	9	22–26	*a*	·75 ml. (hard capsule)	69	5, 7, 1, 2, 0, 0, 0, 0	15	82·1
28	10	16–23	*a*	1 ml. (hard capsule)	144	3, 0, 0, 0, 0, 0, 0, 0, 0, 0	3	97·9
29	10	17–25	*a*	1 ml. (soft capsule)	194	..	0	100·0
30	8	20–24	*a*	1 ml. (soft capsule)	58	..	0	100·0
31	10	18–25	*a*	1 ml. (syringe)	64	7, 4, 4, 3, 2, 2, 0, 0, 0, 0	22	74·4
32	11	16–24	*b*	1 ml. (syrihge)	88	2, 3, 3, 1, 1, 0, 0, 0, 0, 0, 0	10	89·8
33	9	22–26	*b*	1 ml. (soft capsule)	55	..	0	100·0
34	10	18–24	*c*	1 ml. (soft capsule)	128	3, 2, 1, 3, 2, 4, 2, 0, 0, 0	17	88·3
35	9	17–23	*c*	1 ml. (syringe)	34	5, 2, 6, 3, 12, 3, 3, 0, 0	34	50·0
36	8	19–24	*a*	1 ml. plus 1 ml. liquid paraffin	37	53, 30, 8, 0, 0, 0, 0, 0	91	28·9
37	8	22–26	*a*	1 ml. plus 1 ml. liquid paraffin	45	1, 1, 0, 0, 0, 0, 0, 0	2	95·8
38	8	17–25	*a*	1 ml. (soft capsule) and 8 gr. kamala	98	1, 1, 0, 0, 0, 0, 0, 0	2	98·0

* *a* 17 hours' starvation before and 3 hours' starvation after treatment.
b 17 hours' starvation before, fed about 5–10 minutes after treatment.
c No starvation.

Carbon Bisulphide.

In a single test (Exp. 22) with carbon bisulphide three birds, 23 oz., 22 oz., and 19 oz. in weight respectively, were given ·3 ml. in a hard gelatine capsule after seventeen hours previous starvation. No food was allowed for three hours after treatment. Within two hours after

dosing all three birds were noticeably distressed. Next day two had recovered to a slight extent, and were inclined for food. The third bird did not assume a normal appearance till about the fifth day after treatment. A total of twelve worms were passed. Post mortem showed that this dosage had removed all worms from one bird and had left a single worm in each of the other two birds, an efficiency of 85·7 per cent.

Carbontetrachloride.

A large number of tests were carried out with this drug on both young and adult birds as the results secured in the early stages of the work gave indications that carbontetrachloride promised to be more effective than any of the other drugs tested. The results of the trials with young birds are given in Table XXV.

Discussion.

In the first experiment with carbontetrachloride, a ·5 ml. dose in hard capsules to ten birds, 18 oz. to 22 oz. in weight, gave very promising results, an efficiency of 86·4 per cent. being secured (Exp. 23). The same dosage on six birds, somewhat lighter in weight, however, removed only 60 per cent. of the infestation. (Exp. 24). Evidently this dose was not large enough to give good and consistent results in birds of this weight range.

In the next three experiments (25, 26, and 27) a ·75 ml. dose in hard capsules was employed. The effectiveness of this dosage varied from 70·1 per cent. to 100 per cent. in twenty-seven birds, 16 oz. to 26 oz. in weight, giving a total efficiency of 83·1 per cent. It was evident that whilst this dose was highly effective in those birds in the vicinity of 16 oz. weight, it was not so efficient in the heavier birds.

The dose was, therefore, increased to 1 ml., given in hard capsules. The ten birds given this dosage weighed 16 oz. to 23 oz. A total of 144 worms were passed, and three were present on autopsy, an efficiency of 97·9 per cent (Exp. 28). In a further experiment with this dosage, all worms were removed from eighteen birds, 17 oz. to 25 oz. in weight, to which the drug was administered in soft capsules (Exps. 29, 30).

These results indicated that a dose rate of about ·75 ml. per pound weight would be highly effective against *A. galli*. Tests were then undertaken to ascertain the best methods of preparation and administration. In the first place, it was obvious that there was little difference in the efficiencies of the drug given in hard or soft capsules (Exp. 28, 29, and 30). Administration of the drug into the crop by means of a syringe and rubber tubing, however, did not give as good results as when capsules were used. In the twenty-one birds given the drug per syringe the efficiency was 82·6 per cent. (Exps. 31 and 32), whilst that from capsules was 97.9 per cent. to 100 per cent. Experiments were also carried out to see whether the inclusion of equal parts of liquid paraffin would impair the efficiency of the drug to any marked extent. In the first trial (Exp. 36) only 28.9 per cent of the worms were removed. This low efficiency was due to careless administration, the dose being regurgitated by at least two of the birds immediately after its administration. In a further trial, however, an efficiency of 95·8 per cent. was secured (Exp. 37).

As regards preparation of the birds to be treated, experiments were carried out to ascertain to what extent starvation before and after treatment assisted towards the efficiency of the 1 ml. dose. The results

quoted above were secured with pre-starvation and after starvation periods of about seventeen hours and three hours respectively.

With a 1 ml. dose in soft capsules and starvation before and after treatment for these respective periods the efficiency was 100 per cent (Exp. 29 and 30). Without any starvation at all the efficiency was decreased to 88·3 per cent. (Exp. 34), whilst as shown in Experiment 33, a 1 ml. dose given to nine birds with previous starvation only (seventeen hours), food being given five to ten minutes after treatment, gave an efficiency as high as that secured with both pre and after starvation. These results were confirmed by a similar series of experiments in which a 1 ml. dose was administered by means of a syringe. The efficiencies in this group of trials showed that whilst prestarvation only (Exp. 32) did not interfere with the anthelmintic efficiency of the drug, being 89.8 per cent. as compared with 74·4 per cent. with both pre and after starvation (Exp. 31), the omission of starvation entirely gave comparatively poor results, namely 50 per cent. (Exp. 35).

In the final trial (Exp. 38) a 1 ml. dose of carbontetrachloride was given in a hard capsule with 8 gr. kamala, to see whether the inclusion of the kamala would decrease the efficiency of the carbontetrachloride or be followed by toxic symptoms. Neither of these two effects were noted, the efficiency of the treatment being 98 per cent.

As regards the toxicity of carbontetrachloride, an experiment was carried out in which twelve chickens were given dosages varying from 1·5 ml. to 4 ml. per pound weight per syringe, with seventeen hours previous starvation. A dose of 1·5 ml. per pound to three birds, 11 oz., 12 oz., and 13 oz., in weight respectively, was followed by a momentary period of depression in one bird, and during the next six hours the droppings were slightly diarrhœal. Next day all birds appeared bright and normal. A dose of 2 ml. per pound weight to three birds, each 14 oz in weight, was followed by slight inactivity up to about six hours after. After twenty-four hours, the birds were quite bright in appearance, though the droppings were slightly diarrhœal in consistency. A dose of 3 ml. per pound weight to three birds each of 14 oz. weight was followed almost immediately by inactivity, which, however, was only momentary, and was considered to be due to inhalation intoxication. After about three hours, however, all birds were noticeably depressed, which condition, accompanied by diarrhœa, persisted for another thirty-six hours. With a dose of 4 ml. per pound weight, three birds, 11 oz., 12 oz., and 16 oz. in weight respectively, immediately showed the effects of inhalation of the drug, and remained very depressed and inactive with diarrhœa for about ninety-six hours, their recovery commencing from about the third day, and being apparently complete on the fifth day.

During the trials a total of ninety-three birds from 16 oz. to 26 oz. in weight received 1 ml. of the drug, and any symptoms as might be associated with toxicity were rare. On a few occasions the droppings were slightly diarrhœal for up to twenty-four hours after treatment, and in some of the birds given the dose per syringe there was evidence of inco-ordination of movement and inactivity, which effects were of comparatively brief duration, and were considered to be probably due to inhalation of the volatile principles of the drug.

The results from these tests may therefore be summarised as follows:—

1. Carbontetrachloride is highly effective against *A. galli*.

2. The optimum dose for young birds is in the vicinity of ·75 ml. per pound weight.
3. The drug appears to be more effective when administered in capsules than when given per syringe. The type of capsule employed is not apparently of any importance. Carbontetrachloride given with an equal quantity of liquid paraffin appears to be almost as effective as carbontetrachloride when used alone.
4. The experiments on the preparation of the birds before and after the treatment show that a previous starvation period of about seventeen hours (overnight) is necessary for high efficiencies, but starvation after treatment for longer than about five to ten minutes is not required.
5. A single trial, where 10 grains of kamala were administered immediately after the carbontetrachloride did not give any evidence that the inclusion of the kamala impaired the efficiency of the carbontetrachloride to any marked extent.

The results from trials with carbontetrachloride in adult birds are tabulated below. In every case, the birds were subjected to previous starvation for about seventeen hours, but were fed about ten minutes after treatment.

TABLE XXVI.

RESULTS FROM CARBONTETRACHLORIDE (ADULT BIRDS).

No. of Experiment.	No. of Bird.	Weight.	Dosage.	No. Worms Passed.	No. Worms Remaining.	Per cent. Efficiency.
		Lb. oz.				
39	1	3 1	1·5 ml. per syringe	1	..	100·0
	2	3 1		201	..	100·0
	3	3 5		1	1	50·0
	4	3 15		21	2	91·3
	5	2 5		3	2	60·0
	6	2 13		41	1	97·6
40	7	3 5	2 ml. per syringe	43	..	100·0
	8	3 1		125	..	100·0
	9	3 3		77	..	100·0
	10	5 7		5	..	100·0
	11	4 1		148	2	98·7
	12	3 8		19	..	100·0
	13	5 0		81	..	100·0
	14	5 5		26	..	100·0
	15	3 5		39	..	100·0
	16	3 11		1	3	25·0
	17	3 11		7	..	100·0
	18	3 0		4	..	100·0
	19	2 14		2	..	100·0
41	20	4 2	2 ml. in soft capsule	14	..	100·0
	21	3 8		22	..	100·0
	22	2 8		20	..	100·0
	23	3 0		23	..	100·0
	24	3 4		8	1	88·8
	25	3 12		9	..	100·0
42	26	4 11	2 ml. + 2 ml. liquid paraffin	3	..	100·0
	27	3 3		4	1	80·0
	28	4 13		15	2	88·2
	29	5 5		2	..	100·0
	30	3 4		74	8	90·2
	31	4 5		88	16	84·6

Discussion.

In a preliminary experiment, six birds, 2 lb. 5 oz. to 3 lb. 15 oz. in weight were each given 1·5 ml. of carbontetrachloride per syringe. The dosage was very successful in the three cases where a good number of worms were present, being 100 per cent. efficient in No. 2 with 201 worms and 91·3 per cent. and 97·6 per cent. efficient in Nos. 4 and 6, which contained twenty-three and forty-two worms respectively. The dose, however, was only 50 per cent effective in No. 3 with two worms, and 60 per cent. affective in No. 5 with five worms.

In the next trial, the dose was, therefore, increased to 2 ml., which was also administered by means of a syringe. Of the thirteen birds given this dose and which weighed from 3 lb. 1 oz. to 5 lb 7 oz. all worms were removed from eleven, in five of which the infestation was fairly high, namely 39, 43, 77, 81, and 125 worms respectively. In the twelfth bird, the 2 ml. dose removed 148 out of 150 worms, but in the remaining bird three out of four worms survived. These results indicate that 2 ml. dose is very highly effective, but, like the smaller 1·5 ml. dose, may not be as efficient where only a slight infestation exists.

Simultaneously with the above trial, six birds, 2lb. 8oz. to 4lb. 2 oz. in weight, were given 2 ml. in soft capsules. The efficiencies secured, as denoted in Table XXVI. were practically equal to those given by the unencapsuled drug.

In a final test, six birds, 3 lb. 3 oz. to 5 lb. 5 oz in weight, were given 2 ml. of carbontetrachloride with equal parts of liquid paraffin. In the only two birds which were heavily infested Nos. 30 and 31 the mixture removed 90·2 per cent. and 84.6 per cent. of the worms present respectively, whilst in the remaining birds with 2, 3, 5, and 17 worms, the efficiencies were 100 per cent., 100 per cent., 80 per cent., and 88·2 per cent. respectively. It would, therefore, appear that in this experiment the effectiveness of the carbontetrachloride was impaired by the inclusion of the liquid paraffin.

Including birds that were treated but subsequently proved to be non-infested, a total of forty-five adult birds were given a 2 ml. dose in these trials. Symptoms which could be associated with toxicity, were displayed by six birds, in four of which they were only of a temporary nature, and were considered to be due to inhalation of the drug. The remaining two birds, however, remained inactive and depressed for a period of two or three days after treatment. In both of these birds, subsequent autopsies showed disease conditions to be present, which had no doubt lowered the bird's tolerance to the drug. In some of the birds, which were otherwise unaffected, the droppings were slightly diarrhœl in consistency for up to twenty-four hours after treatment.

Conclusions.

Of the various drugs employed in these trials against *A. galli*, carbontetrachloride is considered to be the most efficient.

The effective dose rate is in the vicinity of ·75 ml. per pound weight, but not to exceed a total dose of 2 ml. This dose rate appears reasonably safe, though it may cause momentary inactivity and a slight degree of diarrhœa. The margin of safety is fairly high for a dose rate of 4 ml. per pound weight whilst toxic is not lethal.

Birds to be treated should be starved overnight, treated early next morning and fed a few minutes after treatment.

As regards the method of administration, the experiments with the young birds indicate that the efficiencies of the methods employed may be placed in the following order:—(1) Hard or soft capsules, (2) carbontetrachloride with equal parts of liquid paraffin per syringe, (3) carbontetrachloride per syringe. With the adult birds, on the other hand, the efficiencies secured from the administration of drug per capsule and per syringe were about equal and greater than that of the drug plus liquid paraffin. The liquid paraffin was originally included with the object of increasing the bulk of the dose and also of protecting the bird from any possible toxic effects. The costs of these respective methods of administration, computed from Brisbane wholesale prices on the basis of a 1 ml. dose are as follows:—

(*a*) Soft capsules, 4s. per 100 birds.

(*b*) Hard capsules, 2s. 10d. per 100 birds (exclusive of labour costs for filling the capsules with the drug).

(*c*) With equal parts of liquid paraffin, 10d. per 100 birds.

(*d*) Carbontetrachloride alone, 6d. per 100 birds.

The cost of treatment, using capsules, would on these figures be prohibitive to most poultry farmers. It is also considered that the inclusion of liquid paraffin is not warranted. It is therefore recommended that the drug be given to all birds irrespective of age, by means of a syringe, any loss of efficiency among the younger birds being more than compensated for by the low costs of this method of administration. Admittedly the use of a syringe may be followed by unfavourable sequelæ more frequently than the capsule method of administration, such sequelæ being a temporary period of inactivity, due to inhalation of the drug vapour and not considered to be of any important consequence or death from the introduction of the drug into the lungs through careless administration.

[TO BE CONTINUED.]

POINTING POSTS.



Plate 258.

A simple set-up for pointing stakes or posts is illustrated. All that is required is a fork from a stout sapling, driven a short distance into the ground, at an angle to steady it. The stake to be pointed is rested in the fork, and lies at a convenient slope for slicing with a sharp axe.

Principles of Botany for Queensland Farmers.

C. T. WHITE, Government Botanist.

[*Continued from p. 505, October,* 1936.]

PART III.—PHYSIOLOGY.

THE STUDY OF LIFE PROCESSES OF PLANTS.

CHAPTER XIII.

General.

WHEREAS morphology and anatomy deal respectively with the external form and the internal structure of plants, the study of plant physiology is concerned with the work performed by the various parts of the plant in maintaining the life of the whole. In the lowest forms of life, the different kinds of work or functions may be performed equally by all parts of the plant, but in the higher forms specialisation takes place and there is a division of labour, various members and tissues being adapted to perform the specific functions; these members and tissues are termed the organs of the plant. Thus, in a tree the general functions of the roots are to absorb the mineral food in solution from the soil and to anchor the tree firmly in the earth; those of the stem are primarily to bear the foliage leaves and reproductive organs, and to serve as a means of communication between the roots and the leaves, and so on.

The satisfactory performance of the various functions is dependent partly upon the external conditions being favourable; for instance, growth is checked by very low or very high temperatures, or by the lack of air and moisture, while in the case of green leaves, a sufficient intensity of light is necessary if they are to fulfil their main purpose to the plant. Thus the object of the study of physiology is not only to ascertain the various functions performed by the different organs, but also to trace the relation between the action of the organs and the various internal and external conditions affecting them. It must be realised, however, that the performance of the functions is dependent primarily upon the activity of the living protoplasm, without which all vital processes cease.

General Functions.

The functions of plants, in general, may be divided into two main groups:—

1. The *nutritive functions,* which are concerned with the maintenance of the life of the individual; and
2. The *reproductive functions,* concerned with the production of new individuals resembling itself.

Functions of the Tissues.

Distinction must be made, in dealing with this subject, between the vital functions depending upon living protoplasm and the purely physical functions depending upon mechanical properties.

1. The tegumentary tissue, which includes the epidermis of the leaves and the bark of the stem, is primarily of importance, in that it

affords to the delicate interior tissues protection against heat, cold, injury by fire, and other causes.

Excessive loss of water by transpiration and evaporation is also prevented, and, it will be noticed, as a general rule, that the development of this tissue varies directly with the rate of transpiration which external conditions promote. The leaves of Eucalypts, Wattles, and other plants growing in open forest country are better protected than the leaves of those species which are found under the shade of dense forests—as the shrubs and smaller trees of the scrub or rain-forest. In like manner, the leaves of trees of hot, dry climates, are, as a rule, better protected than those of the more temperate regions.

Provision is made for the escape from the plant of water vapor, to which the tegumentary tissue may be impermeable by the development of lenticels and stomata (Plate 210), transpiration being regulated by the opening and closing of the latter.

2. The parenchymatous tissue consists principally of active cells containing living protoplasm, and discharges primarily the different nutritive functions, which vary according to the position of the tissue; thus, that present in the leaves and exposed to the influence of light contains chlorophyll and is responsible for the assimilation of carbon and the manufacture of organic food material.

The parenchymatous cells also serve as storehouses of reserve material, such as starch, and help in the transfer of organic material. Being frequently glandular, they excrete waste products.

The cell-walls not being lignified or cutinised, the cells are generally capable of extension, and, consequently, of becoming turgid and giving rigidity to the member of which they form part. When deprived of water they contract, the rigidity of the member being thus affected; this is well shown by the wilting of leaves under the influence of drought.

This tissue frequently contains numerous intercullular spaces which are of special importance in assisting the movement of gases in the interior of the plant, and in connection with transpiration, communication with the external atmosphere being affected through the stomata and lenticels.

3. The sclerenchymatous tissue, especially when fibrous, exercises the mechanical function of giving strength to the member, and hence is but slightly developed in aquatic plants, while it is of much greater importance in the stems of land plants.

4. The tracheal tissue of the wood functions primarily as a conducting agent, through which water and the mineral solutions absorbed by the roots are transferred to the leaves, it being incapable of vital action in that it contains no protoplasm.

If the stem of a tree be completely girdled by a cut which goes through the sapwood into the hardwood, the continuity of the tracheal tissue is interrupted and the leaves are deprived of moisture and mineral food, with the result that they wilt and die, causing the death of the whole tree unless adventitious shoots—"suckers"—arise from the stem below the cut and thus maintain the life of the roots and butt.

5. The sieve tissue of the phloem or bast contains living protoplasm, which in some way or other enables the tissue to perform its principal

function—viz., that of conducting the organic food material manufactured in the leaves to those parts of the plant which either consume it or store it as reserve material.

The effect of destroying the continuity of the sieve tissue by removing a ring of bark from the stem of a tree—i.e., ringbarking—is that the roots cannot receive the organic food manufactured by the leaves, and are forced to subsist on the reserve food material stored by them. After this reserve supply is exhausted the roots succumb and, therefore, the whole tree dies. It is important to note that death caused by ringbarking is caused in a different way from death due to ringbarking and sapping—as dealt with under the tracheal tissue—and, moreover, takes place more slowly. It is possible with some species that ringbarking alone will not cause death, because the reserve supplies stored in the roots are sufficient to enable them to exist until a new layer of bark is formed and continuity of the sieve tissue re-established.

6. The glandular tissue has for its chief function that of secretion either of waste products or plastic substances. Of the former, the resin in the resin-ducts of Conifers, and kino in the "gum veins" of certain Eucalypts, the ethereal oils in the leaves of Eucalyptus, Citrus, and many other plants, and the milky latex in rubber-producing trees are familiar examples. The particular service which the secretion of waste products does for the plant itself—apart from the removal of waste material not needed for the formation of plant tissue—is not always understood. In the case of conifers, the "bleeding" of a wound certainly helps to afford mechanical and antiseptic protection to the exposed wood, preventing the entrance of fungi liable to cause disease.

The secretion of plastic substances is frequently concerned with the relation of insect life to the life of the plant—e.g., the excretion of sugar by a flower serves to attract insects which bring pollen from other flowers and thus ensure cross-pollination. The excretion of sugar on parts other than flowers frequently attracts ants, which help to check the attacks of other insects which are injurious.

Functions of the Members.

The root system of the plant has two functions—namely, to ensure by its hold on the soil the stability of the plant, and to absorb in solution all the mineral food required for its existence.

When first developed, the whole of the root performs both functions, but in trees and shrubs that portion of the root system nearest the stem develops a woody nature in order that it may be strong enough to hold the plant firmly in the soil. The absorptive power of the woody portion is lost, and that function is performed by the more delicate parts of the root system further removed.

The root system also serves as a storehouse for reserve organic food material manufactured by the plant, and in some cases, particularly in vegetables such as the Carrot, Turnip, &c., tuberous roots are specially adapted for the storage of large quantities of food.

The absorptive power of roots is dependent primarily upon the walls of the superficial cells of the absorbing parts being not cuticularised, but readily permeable by aqueous solutions. These superficial cells frequently send out fine root-hairs, by which the absorbing surface

is greatly increased and more intimate contact with the moist soil obtained. This absorptive portion is relatively short, being situated just behind the growing tip.

It has been taken as a general rule that the water content in herbaceous plants averages 75 per cent. or more of the whole; in plants such as trees or shrubs with a considerable amount of dead tissue and thick, woody cells and fibres the percentage would, of course, be below this, but it would seem safe to say that in all cases the living cell contents consist of 80-90 per cent. of water, or even more.

It naturally follows that the amount of water required by large freely-growing trees is tremendous, and consequently their root systems, especially under dry conditions, extend very widely and branch extensively in order that sufficient moisture may be obtained from the soil.

The Stem.—The physiological function of the stem is simply that of connecting the roots with the leaves, acting as a support for the latter and the reproductive organs, and serving as a conducting channel for the transference of sap from the roots to the leaves, and organic food from the leaves to the roots.

The development of the stem depends upon the extent of the leaf surface which it has to support and the strains which the exposure to winds, &c., renders it necessary to bear. The tremendous strains which the trunks of large trees have to withstand show what wonderful structural qualities timber must of necessity possess.

The Leaf.—The main functions of the foliage leaf are:—

(i.) The absorption from the air of carbon dioxide and the utilisation of the carbon in building up organic food compounds;

(ii.) The exhalation of water vapor or transpiration;

(iii.) The absorption of oxygen from the air in the process or respiration.

The structure of the mesophyll of the leaf is such as to enable these functions to be performed satisfactorily.

As previously described, beneath the epidermis on the upper surface of an ordinary flat leaf or on both sides of a vertically placed leaf, such as in Eucalypts, is the palisade parenchyma; it is very rich in chlorophyll, whose action is possible only under the influence of light. The elongated form of the palisade cells enables the chloroplasts to arrange themselves along the outside walls so as to receive as much light as possible in diffuse light, or when light is very intense to remove to the lateral and interior walls.

The spongy parenchyma, which is on the lower or less exposed side of the leaf (or in the middle of a round or in a vertically placed leaf), also contains chloroplasts, but is especially adapted for transpiration and absorption of oxygen. Its cells are very irregular, and the tissue contains many intercellular spaces which communicate with the air by means of the stomata and with the interior of the plants as a whole. Thus rapid exchange of gases and water vapor is rendered possible.

CHAPTER XIV.

Osmosis, Absorption, and Transpiration.

Osmosis.—If a bladder be filled with a solution of sugar, the opening tightly closed and the bladder placed in a vessel containing

water, it will be found that the bladder will expand, there being a transference from the vessel into the bladder, even though there be no visible openings through which the water can enter. At the same time the water in the vessel will become sweet, showing that sugar passes outwards through the bladder. The weaker solution diffuses faster than the stronger; thus dried fruits rich in sugar, when placed in water, swell rapidly, and the water in which they are soaked becomes sweetened. Eventually a degree of stability is reached and transfusion apparently ceases.

This transference or diffusion of liquids and solutions through the wall of the bladder or any other permeable membrane is known as osmosis, and the pressure which is set up inside the bladder is called osmotic pressure. The bladder in the distended condition is said to be turgid. If the pressure set up is too great, the bladder may burst.

The splitting of ripe fruits in a wet season is due to the turgid cells rich in osmotic substances such as sugar not being able to cope with the pressure set up by the excess of water supplied by the roots.

Not all substances which are soluble in water can diffuse through membranes permeable to water, and a distinction is made between diffusible substances, or crystalloids, and the non-diffusible, which are termed colloids.

The Plant Cell.—A living thin-walled parenchymatous cell is essentially a compound osmotic cell, of which the bladder is a simple model. The plant cell has more than one osmotic membrane through which diffusion takes place, for the cell-wall is one, while the protoplasm with its internal and external layers is a series of osmotic membranes, which may refuse to allow the passage of a substance which has passed through the cell-wall. Taken as a whole, however, and in a broad general sense, the cell-wall and the protoplasm may be compared with the bladder, the cell sap with the internal solution, and the moisture in the soil or in the adjoining cells with the solution in which the bladder is immersed.

The turgidity of the plant cell, which, in spite of its very delicate structure, gives firmness and rigidity to the growing parts of a plant, is due to the osmotic pressure of the cell sap, causing the protoplasm to be pressed firmly against the cell-wall.

The wilting of leaves on a cut stem is due to the fact that the water which is evaporated through the leaves is not replaced by water supplied by the roots, with the result that the cells in the leaf lose their turgidity. If the cut stem is immersed in water before the loss has proceeded too far, the cells obtain water through the cut surface and become turgid again; but this recovery is not effected if the upper part of the shoot only be placed in water, for the external cell-walls of the epidermis of the leaf and branchlet are cuticularised and do not allow the passage of water into the interior of the leaf, which must be supplied through the stem, either by the roots in the living plant or through the newly cut surface in the case of a cut stem.

Similarly, wilting takes place during drought, when the loss of water from the leaves is greater than can be taken up from the dry soil, and under very severe conditions death may be caused, even in such deep-rooted plants as many of our western trees and shrubs.

Absorption.—The food of the plant is built up from the materials which the plant is able to absorb from the air and the soil—carbon dioxide from the air, and mineral salts from the soil.

No plant cell is able to take in solid matter from the soil through its cell-wall, and consequently the supply of mineral salts must be obtained in aqueous solution by the process of osmosis, which is at the foundation of all plant life.

The absorption of solutions is rendered possible by the fact that the external cells of root-hairs and of the younger parts of roots have thin, uncuticularised walls, which allow the passage of water from the outside as freely as the transference from cell to cell is allowed inside the tissue. Owing to the absence of cuticularised tegumentary tissue, those parts of the roots which are capable of absorption are very delicate; consequently, they are easily broken during the process of transplanting, so that transplanted seedlings frequently suffer from want of water until new root-hairs are formed.

Transplanting is specially liable to failure if followed by hot, dry weather, which causes loss of water when the seedling is temporarily deprived of its absorbing rootlets and root-hairs and is thus unable to maintain the necessary supply of water.

If the strength of the salt solutions in the soil is greater than that of the cell sap of the rootlets, not only will the latter not be able to obtain food materials by osmosis, but their cell contents may shrink, and death may ensue; hence the effect of manuring a young plant very heavily with a readily soluble manure may not be improved but diminished growth, and in some cases even death. It has been found that solutions containing over 2 per cent. of dissolved substances are injurious to plant growth, and very weak solutions containing under 5 parts of dissolved substances in 1,000 give the best results.

The quantity of soluble material absorbed by the roots decreases with low temperatures, and consequently in cold winters growth may cease, while warm rains cause much better growth than cold rains. Also, the rate at which a plant is growing determines the amount of substance absorbed, for if there be no internal movement of cell sap in the plant it is obvious that—as in the case of the bladder—a position of equilibrium will be reached between the sap of the absorbing cells and the moisture of the soil. If, on the other hand, the plant is growing vigorously, there is continuous transference of sap from the roots to the leaves, the equilibrium is continually destroyed, and absorption by the roots continues.

The vital processes of the roots are dependent on an adequate supply of oxygen, without which poisonous compounds are formed and an unhealthy condition results. Consequently, except for species adapted to the conditions, growth in badly-drained and waterlogged soils is unsatisfactory, this being accentuated by the fact that wet soils are cold and frequently below the temperature best suited to the plant.

Notwithstanding the fact that the fine rootlets and root-hairs are in very close contract with the soil, they are not capable of absorbing all the water therein, and when the percentage of moisture in the soil falls below a certain minimum the roots are unable to obtain supplies. The percentage of water available to the plant varies considerably with the physical character of the soil; thus in loose sand plants may be able

to avail themselves of the water in it even when the water content falls as low as 1 or 2 per cent.; on the other hand, in a heavy, clayey soil the minimum water content may be as high as 25 per cent.

Root Pressure.—The solution absorbed by the external cells of the roots passes by osmosis into the neighbouring cells, all of which in turn become turgid owing to the development of osmotic pressure. Finally the high pressure in the cells adjoining the tracheal tissue causes the cell sap to be forced into the vessels and tracheids, the pressure developed therein being known as the root pressure.

If the stem of the plant be cut, the existence of a positive root pressure is manifested by the exudation of water from the cut vessels, this phenomenon being known as bleeding.

Root pressure is most in evidence during the actively growing periods. In deciduous plants it is most easily seen in the spring and early summer before the plants have used the water with which the roots have become saturated. Later in the season, when the excess supplies have been used up, a partial vacuum is created and a negative pressure is registered, water being sucked in by, instead of forced out from, the cut stump.

Transpiration.—Every part of a plant which is exposed to the air, unless protected by impervious corky layers, is subject to the loss of water by evaporation. The exhalation of water vapour from leaves can be demonstrated by placing a leafy stem under a jar or in a test tube with the end closed by cotton wool, when a deposit of dew will soon be observed on the inside of the glass.

This exhalation of water vapour from living plants is called transpiration, and the flow of aqueous solution necessary to replace the water so lost or otherwise utilised is called the transpiration current. Transpiration, though depending primarily upon the ordinary physical process of evaporation, is distinguished therefrom in that it is evaporation modified and controlled by the living plant.

That a plant cannot control transpiration absolutely and cause it to decrease in proportion to the available supplies of water is, however, shown by the wilting of leaves under the influence of drought, or when the root system is deprived of its absorbing parts.

Transpiration from the exposed external surface of a plant is rendered comparatively unimportant by the development of protective covering layers to the outer tissues, as in the epidermis of the leaves, and cork of the bark, and the cuticle of fleshy fruits and species of cactus. Also, in some cases a covering of woolly hairs or waxy bloom serves as protection against loss of water.

The transpiration which accounts for most of the loss of water is that which takes place from the thin-walled cells beneath the external tissue, these cells being connected with the atmosphere by the intercellular spaces through the stomata (Plate 210) of the leaves and the lenticels of the bark.

The opening and closing of the stomata regulate and control to a large extent the transpiration from the leaves. When the guard-cells are full of cell sap and highly turgid, they curve away from one another, leaving a wide opening through which the water vapour can pass. When the supply of sap is low and further loss is dangerous, the guard-cells

become flaccid and are drawn together, thus closing the aperture and preventing transpiration. The guard-cells are affected not only by the condition of the plant but also by the atmosphere. When the air is moist and there is no danger of excessive transpiration, the stomata open, closing, on the other hand, when the air is very dry.

Various means are adopted by plants to reduce transpiration. The leaves, or the flattened stems which take their place, may, like those of the Prickly-pear, be thick and fleshy, capable of storing large supplies of moisture, transpiration of which is prevented by the specially well-developed cuticle. Also, as in the case of Eucalypts, the petiole of the leaf may be twisted so that the leaf lies more vertically than horizontally, and thus does not receive the full rays of the sun. In Casuarina the leaves are reduced to small scales and the stomata situated in the narrow grooves of the cladodes. In some species of *Banksia* or Honeysuckle Oaks (*e.g., B. serrata* and *B. æmula*) the stomata occur in small pits on the under surface of the leaf and are still further protected by hairs. The margins of leaves in many cases are revolute, particularly in drier times, as may be seen in some species of *Banksia, Ricinocarpus, Westringia,* &c. The protection thus afforded to the stomata decreases transpiration very greatly and accounts in large measure for the ability of the species to resist dry conditions. On the other hand, the leaves of plants which inhabit wet, swampy situations may have special adaptations for furthering transpiration, such as a thin cuticle, a large exposed leaf surface, exposed stomata, and in some cases (*e.g.,* Willows) may even be unable to close their stomatal guard-cells.

Transpiration Current and Ascent of Sap.—In the foregoing pages it has been shown that the supply of moisture to the roots is maintained by osmosis and that the loss of moisture from the leaves is due to transpiration. There remains to be explained the maintenance of the transpiration current from the roots to the leaves and other transpiring surfaces.

Numerous attempts have been made to ascertain the origin of the force which drives the transpiration current, and the literature on the subject is very wide. The pressure necessary to raise sap to the height of tall trees is obviously great.

At one time it was thought that the sap travelled in the living parenchymatous tissue from cell to cell by the process of osmosis. The rate of diffusion by such means is, however, very slow, and could not possibly supply the needs of large trees, apart altogether from the fact that it has since been established that the tracheal tissue of the xylem is the conducting channel.

In small plants the root pressure may be sufficient to force liquid from the roots to the leaves, but this is quite inadequate in the case of large trees.

Although investigators have been for many years, and still are, at work endeavouring to account for the rise of sap, all efforts have been unsuccessful. The theories advanced take into account various possibilities, such as the movement of water through the walls, instead of the channels, of the conducting tissue, the action of capillarity, the suction force caused by transpiration and osmosis in the leaf-cells, &c. As a result of the various experiments performed, it may, however, be stated that it is practically certain that physical forces are not wholly responsible and that the vital activity of living parenchymatous cells, such

as are found in the medullary rays of the wood, cannot be left out of account, but are a prime factor in supplying the necessary force.

CHAPTER XV.

Chemical Composition and Food of Plants.

When a plant is dried and all the water contained in the cell sap, cell-walls, and the protoplasm expelled, the remainder consists of a considerable number of chemical compounds, both organic and inorganic; the latter consist of that part of the absorbed mineral salts which at the time of death had not been utilised, while the former are the compounds manufactured from the food materials absorbed from the soil and the air.

The number of different compounds discovered in plants is extremely large, and research is continually adding to the number, which it is neither possible nor necessary to specify here. For general purposes they may be divided into nitrogenous and non-nitrogenous compounds—*i.e.*, those which do and those which do not contain nitrogen.

Non-nitrogenous Compounds.

The most important substances contained in this group are the carbohydrates, fats, essential or volatile oils, acids, and glucosides.

Carbohydrates are composed of carbon in combination with hydrogen and oxygen, the two latter elements being present in the same proportion as that in which they occur in water. The combinations in which these three elements occur are many, but the most important are cellulose, starch, and sugars.

Cellulose enters very largely into the composition of the cell-walls, which are produced by the protoplasm. In those cell-walls, which are adapted to various requirements, as in the cork, the lignified tissue, &c., the cellulose is found to vary in composition and to be combined or intimately associated with other compounds, such as suberin, lignin, cutin, &c.

The cellulose of plants is the main constituent of paper pulp, in the manufacture of which the chief difficulty is the removal of the combined substances without injuriously affecting the cellulose.

Starch is the form in which the plant stores much of its reserve organic food, and is of very frequent occurence in plants, particularly in the roots. A noteworthy example of the storage of starch in forest plants is furnished by the stems of the "zamia" palms (*Cycadaceæ*), while seeds (*e.g.*, cereals particularly) and tubers (*e.g.*, the potato) are very rich in this compound. Starch occurs in the form of minute grains. They are produced by the plastids, and under the microscope exhibit a stratified appearance, each grain being composed of several successive layers built round a central nucleus or *hilum*. The existence of starch grains can be readily seen on treating with iodine, with which starch gives the familiar blue reaction.

Plants rich in starch constitute a very large proportion of the food of man, cereals, such as wheat, maize, rice, &c., and roots or tubers,

such as potatoes, sweet potatoes, yams, taro, cassava, &c., being of value largely on account of their high starch content.

Commercial starch is prepared by mechanical separation with water from any starchy material, such as potato or arrowroot tubers, maize, rice, or other grains.

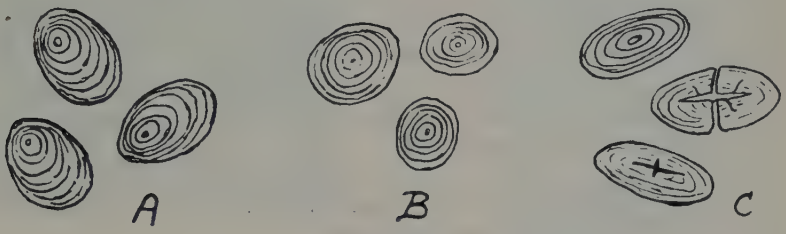


Plate 259.

STARCH GRAINS.

Starch grains are of various shapes. Those of the potato, arrowroot, &c. (A) are oval with an excentric hilum; those of wheat (B) lenticular with a more or less central hilum; those of beans, peas, &c. (C) are oval or somewhat kidney-shaped with cracks or fissures radiating from the centre.

Sugars are generally found in the cell sap and occur most commonly in fruits. The sugar-cane, sugar beet, and the sugar maple of America are familiar examples of species which are specially rich in sugar.

Fats and fixed oils are reserve plant foods, and are found more particularly in fruits and seeds; familiar examples of species rich in oils are the olive, the castor oil plant, the rape, the coconut, the cotton, and the candle nut.

Fats and oils may be extracted from seeds by pressure, solvents, or boiling with water. The numerous commercial oil-cakes, largely used as cattle and poultry foods, are made from the residue of different seeds and fruits after the oil has been extracted by pressure.

Vegetable fats and oils are used for various purposes, as medicine, food, heating and lighting, lubricants, and in the manufacture of soaps. Some oils possess the property of drying and becoming hard when exposed to the air; they are known as "drying oils," and are largely used in the manufacture of paints and varnishes. The most widely used is that obtained from the seeds of the flax plant—viz., linseed oil; another widely used drying oil is that obtained from the seeds of the Chinese tree *Aleurites Fordii*. The oil is known in commerce as Tung oil or Chinese wood oil, and is used in the manufacture of paints, varnishes, linoleums, &c.

Essential oils, resins, &c., are generally waste products and are secreted in special glands or ducts, of which the oil dots of the leaves of Eucalypts and the resin-ducts of Conifers are well-marked examples. To the essential oils is frequently due the characteristic odour of plants, while (as in *Eucalyptus, Backhousia,* &c.) they are the source of valuable commercial oils and perfumes.

Gums, resins, and kinos are yielded by many plants, and, as these terms are of frequent use in technological works, the following brief definitions and notes on them are here given:—

(*a*) Gums are entirely soluble or swell up in water, but are insoluble in alcohol (spirit)—*e.g.*, *Acacia* spp. (Wattle gums), *Melia* (White Cedar), &c. Wattle gums are principally of value industrially on account of their adhesive properties. Gum arabic is the produce mostly of *Acacia Senegal*, a native of Western Africa.

(*b*) Resins are entirely soluble in alcohol, but insoluble in water—*e.g.*, *Xanthorrhœa* spp. (Grass Tree gums, Yacka gum, or Gum Acaroides).

Oleo-resins are mixtures of essential oils and resins; they are principally yielded by species of Conifers and occur in special canals or cavities.

Turpentine or oil of turpentine is obtained from oleo-resins by distillation; the non-volatile residue after being cleaned forms the solid rosin of commerce.

Canada balsam is the oleo-resin of *Abies balsamea*, a North American tree, the resin of which contains a preponderance of turpentine oil.

(*c*) Gum-resins are mixtures of various gums and resins, and are party soluble in alcohol and partly in water—*e.g.*, the gum-resins of *Grevillea robusta* (Silky Oak), *Pittosporum undulatum*, &c.

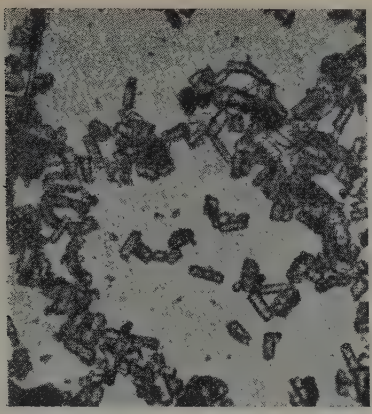
(*c*) Kinos are dry, hardened juices of plants containing quantities of dark colouring matter—*e.g.*, *Eucalyptus* and *Angophora* kinos. Kinos are used industrially in tanning and dyeing.

Organic Acids, though occuring free, are more commonly found united with bases to form salts. The acid most commonly met with in plants is oxalic acid, which in combination with calcium forms the crystals of calcium oxalate found in living cells; other well-known acids are tartaric, citric, and malic, common in unripe fruit.

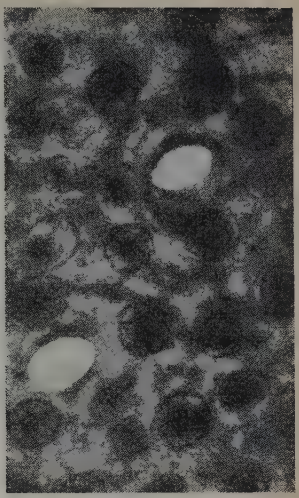
Crystals of calcium oxalate (oxalate of lime) vary somewhat in the form in which they occur in plants. In some cases they occur in an elongated needle-like shape, when they are spoken of as raphides and usually occur in groups.

This form is characteristic of many monocotyledonous plants, especially the Aroids—*e.g.*, the Cunjevoi, Taro, Dasheen, &c. When a piece of green stem or leaf of the Taro, Cunjevoi, or allied plant is chewed, the tongue, roof of the mouth, and lining of the throat seem to be pierced by innumerable little needles giving intense irritation, and, in fact, if chewed to any extent, great agony. After thorough cooking, however, these plants are edible, and the Taros form a large proportion of the food of many native races, particularly in the Pacific Islands.

Plate 260, C and D, represent raphides in the tissues of the leaf of the Taro (*Alocasia antiquorum*). The illustrations are taken from photomocrographs by Messrs. Lyman, Kebler, and Howard in W. E. Safford's "Useful Plants of the Island of Guam" ("Contributions



A



B



C



D

Plate 260.

CALCIUM OXALATE CRYSTALS IN PLANT TISSUES.

A.—In bark of Eucalyptus (after Smith).
B.—In epidermal tissues of Prickly-pear (after Shirley and Lambert).
C. and D.—In leaf tissues of Taro (after Safford).

from the United States National Herbarium," Vol. IX.). In this plant and its allies these authors state that the raphides are enclosed in what appears to be an elongated transparent capsule filled with mucilage. These capsules or cartridges are situated in the partition wall between two vacuoles, their ends projecting into the adjacent vacuoles. When the vacuoles become filled with water by being crushed in chewing or when artificially macerated, the mucilage absorbs water through the capsule walls, increasing in volume so that it exerts such a pressure that the needles are projected with considerable force from the capsule at one or both ends, where the cell-wall is thinner than at the sides.

Among Dicotyledons raphides are well developed in the *Ampelidaceæ* (Grape Vines, Water Vines, &c.) and in *Vitis acris,* a common "scrub" or "brush" climber in parts of Eastern Australia; the green stem, if chewed, causes intense irritation to the soft parts of the mouth and throat, due to the presence of numerous raphides of calcium oxalate in the plant's tissues.

H. G. Smith has shown that calcium oxalate is abundant in the barks of Eucalypts in the form of well-defined simple crystals. Plate 260 (A) represents these crystals, and is taken from a photomicrograph by H. G. Smith in the "Journal and Proceedings of the Royal Society of New South Wales," Vol. 39.

Calcium oxalate commonly occurs in the form of clustered crystals (termed sphæraphides), and Plate 260 (B) shows sphæraphides in the common Prickly-pear or Pest Pear (*Opuntia inermis*), and is taken from an illustration by J. Shirley and G. Lambert in the "Proceedings of the Royal Society of Queensland," Vol. 26, where these authors state that these sphæraphides form an effective armour against insect attack. Sphæraphides are abundant in the Oxalidaceæ (Wood Sorrel, Soursob, &c.) and Polygonaceæ (Sorrel, Rhubarb, &c.).

Glucosides may be nitrogenous or non-nitrogenous; common examples are tannin (in Wattle and other barks), amygdalin (in the seeds of Bitter Almonds), salicin (in the bark of Willows), and dhurrin (in Sorghums). Their exact functions or their nutritive value to the plant is unknown, but a knowledge of their distribution in the vegetable kingdom is of great importance from an economic standpoint.

In some cases the glucoside may have the property of yielding, on disintegration and destruction of the plant cells by the digestive apparatus of animals, the powerful poison hydrocyanic (or prussic) acid. Such glucosides or the plants which contain them are termed cyanophoric or cyanogenetic. Their presence accounts for the poisonous character of the seeds of the Bitter Almond, and some other seeds and nuts, and explains the poisoning of stock by such plants as the Sorghums and some other grasses, by the Native Fuchsia (*Eremophila maculata*), Peach-leaf Poison Bush (*Trema*), &c. A remarkable fact about these so-called cyanogenetic or prussic-acid-yielding glucosides is their common occurrence in immature plants or the young parts of plants and their absence from older plants, or older or matured parts; a further remarkable fact is their occurrence in a particular species in one locality and their entire absence from the same species in another locality, though the two places may be only a few miles apart; they are also often very transient in their occurrence, as has been found in the Peach-leaf Poison Bush (*Trema*), appearing and disappearing in this plant in an

apparently erratic fashion. What causes the formation of the glucoside, and its consequent disappearance, has not yet been found, nor is it clear what part these prussic-acid-yielding glucosides play in the life of the plant.

The astringent compounds, known as tannins, are also glucosides; the value of definite knowledge of the tannin contents of different trees, particularly of their barks, is at once obvious; here again the amount present may vary somewhat with the age of the tree and the locality in which it is growing. In South Africa a good deal of attention has been given to the tannin content of the bark of the Australian Wattle (*Acacia mollissima*), cultivated extensively there, with the result that continued breeding from selected trees has much increased the average tannin content.

The saponins are another group of glucosides, a knowledge of which is of importance from an economic standpoint; their presence in a plant or part of a plant can generally be detected, primarily by the marked frothing they cause in water. The commercial value of the Quillaja Bark (*Quillaja saponaria*), of the native Foam Barks (*Sapindaceæ* spp.), is due to the presence of saponins. They are commonly poisonous, and it is thought that the harmful property of the seeds of the Bean Tree, a Moreton Bay chestnut (*Castanospermum australe*), which cause severe purging in stock is due to the presence of a sapo-toxin. Another example is the Finger Cherry (*Rhodomyrtus macrocarpa*), the fruits of which, if eaten in any quantity, cause blindness; parts of this plant apparently contain a poisonous saponin, which has been suggested as the cause of the trouble.

Nitrogenous Compounds.

Prominent in this group are the proteids and alkaloids, the first-named being of special importance because proteid compounds are the main constituents of protoplasm.

The vegetable proteids, proteins, or albuminoids are numerous, and vary greatly in chemical composition. They may occur either in solution dissolved in the cell sap or as solid forms, as the aleurone or proteid grains of cereals and seeds. Proteid substances are of particularly high food value—in fact, no animal can live unless its food contains a sufficiency of them. In cereals the aleurone grains are usually confined to the outermost layers of the cells of the endosperm; thus comes about the lessened food value of artificially polished cereals, such as polished rice, &c.

Alkaloids are generally poisonous, and are to be regarded as waste products—not as food. They form the basis of many of the drugs used in medicine, and familiar examples are nicotin (tobacco), quinin (cinchona), morphia(poppy). The bitter flavour of the barks of many Australian trees, such as Quinine Tree (*Alstonia constricta*), &c., is due to the presence of alkaloids. To their presence is also due the harmful nature of many plants known to be poisonous to stock in Australia, as the Heart-leaf Poison Bushes (*Gastrolobium* spp.), Thorn-apples (*Datura* spp.), &c.

The Elementary Constituents of Plant Food.—If a dried plant be burned, carbon, hydrogen, oxygen, and nitrogen escape into the atmosphere as gaseous compounds, such as carbon dioxide and ammonia, while the other elements remain behind in the ash in composition with part of the carbon and oxygen. By weighing the green and dried plant and

the ash and analysing the composition of the latter, the proportion of water and the various constituent elements in the green plant are obtained.

The existence of any element in the ash of a plant is not proof that that element is indispensable to the plant's existence, for some have been found by the methods of sand and water culture to be not essential to the vital processes. In the grasses and sedges, for example, silica is found in great abundance, principally in the cell-walls, and may constitute from 40 up to even 70 per cent. of the ash of such plants, but experiments have shown that they can be brought to maturity without it, though the resultant plants will be soft and weak, silica being of importance in the strengthening of the cell-walls. Experiments have shown, however, that unless all of the ten elements—carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, potassium, calcium, magnesium, and iron—are available, life is impossible; doubt exists as to the absolute necessity for sodium and chlorine, culture without these elements being so difficult, but the general belief is towards their being non-essential. The special functions of the different elements in plant nutrition has long been the study of plant physiologists; thus, among other things it has been found that potash is essential in the formation of starch, while a certain amount of iron seems necessary in the development of leaf-green or chlorophyll.

Carbon.—Carbon is an essential component of protoplasm and comprises in all generally between 40 and 50 per cent. of the dry weight of plants.

An idea of the amount of carbon present in plants is afforded in charcoal-making. In the manufacture of charcoal, the wood is burnt without free access of oxygen, with the result that the hydrogen, oxygen, and nitrogen of the plant are set free, but the carbon remains with a small quantity of ash. When burnt in the ordinary way, the carbon and oxygen combine and are given off in the form of carbon dioxide.

Although green plants may obtain some carbon in combination from the soil, the bulk of their supply of this element is taken up by the leaves from the carbon dioxide of the air, this action being dependent upon the existence of chlorophyll in the leaves and the access of sufficient light.

Certain green plants are said to be insectivorous because they are specially adapted to absorb carbon in organic compounds. Their leaves bear appendages which excrete a viscid liquid, which attracts and holds insects. The glands then excrete an acid liquid, which dissolves the insect into a form suitable for absorption. The common Sundews (*Drosera* sp.) provide well-known examples of this habit.

Fungi and many other plants known as parasites and saprophytes, which exist on and destroy living and dead organic matter respectively, are almost or quite devoid of chlorophyll and obtain their carbon in the form of organic compounds. Others obtain their carbon from green plants without destroying them, the association of two distinct plants in this way being termed symbiosis. The most common example is furnished by lichens, in which fungi and algæ are associated symbiotically.

An interesting case of supposed symbiotic relationship between the lower and higher plants occurs in the association of certain filamentous fungi and the roots of some flowering plants; this association of fungus

and root has been termed mycorhiza. It is the common state in saprophytic plants, many of which possess little or no chlorophyll, but has also been observed in green leaf-bearing trees, such as the Pines, which possess few or no root-hairs. The hyphæ (roots) of the fungus may penetrate into the cells, or may only pass between the cells of the root tissues. In trees which exhibit mycorhiza, the roots are usually closely invested by the fungus threads, and it is believed that these latter are not only of importance to the tree as absorbing organs for water and nutrient salts, but possibly in the formation of nitrogen. On the other hand, the fungus obtains carbohydrate food substances from its host, and its hyphæ are, no doubt, first attracted to the root by the presence therein of these food substances; the whole matter, however, is one that is still in the field of investigation. In the case of saprophytes, as these plants contain little or no chlorophyll, they would seem to be entirely dependent on the fungus for their organic food supply, the fungus being able to take up carbon compounds present in the remains of dead animals and plants on which it grows.

Some parasitic plants are well provided with chloroplasts and are thus able to obtain their necessary supplies of carbon from the carbon dioxide of the air and utilise it in the building-up of organic food substances; such plants are only partially parasitic, the best-known examples being probably the Mistletoes, which obtain from the host only water and nutrient salts held in solution, but make no demands on it for complex organic food substances. Other plants rich in chlorophyll, but which rely very largely on other plants for their supplies of water and mineral salts are some, if not all, of the Santalaceæ, among the members of which known to be so parasitic are the well-known Sandalwoods (*Santalum* spp.) and the Native Cherry (*Exocarpus cupressiformis*), also some of the Scrophulariaceæ, one of which—*Striga parviflora*—is a well-known parasite on sugar-cane in Queensland. The Santalaceæ and Striga mentioned are parasitic on the roots of their hosts. The Dodders (*Cuscuta*) and Dodder Laurels (*Cassytha* spp.) are plants that have almost completely lost their chlorophyll and have become practically entirely dependent on the host for their sustenance; the first belong to the Convolvulus family (*Convolvulaceæ*), and several are parasitic or economic plants, one—the common European Dodder (*Cuscuta europæa*)—being a particularly bad pest in lucerne cultivation; the Dodder Laurels, which are degenerate members of the Laurel family (*Lauraceæ*) and are very similar in general appearance to the true Dodders, are principally Australian species, and are commonly seen growing over native shrubs.

Hydrogen and oxygen, as has been seen, are found in combination with carbon in numerous compounds, while combined as water they form more than 50 per cent. of the wet weight of the plant. Oxygen is absorbed directly from the atmosphere, while it is taken from the soil in solution in water and in various salts such as nitrates, sulphates, phosphates, &c. Hydrogen may be absorbed in ammonia compounds, but is obtained chiefly in the water taken from the soil.

Nitrogen is an essential constituent of protoplasm and is very abundant in peas, beans, and other leguminous plants. Fungi, parasites, saprophytes, &c., absorb it in organic form just as they do carbon, but

though it is present in the air in large quantities, it is not directly absorbed therefrom, as is the case with oxygen and carbon dioxide.

Certain green plants are able to obtain their nitrogen from the air by virtue of their symbiotic association with bacteria in the well-known nodules of the roots. These symbiotic bacterial nodules are mostly found on the roots of clovers, peas, beans, wattles, and other plants belonging to the pea family (*Leguminosæ*). Generally, however, green plants have to rely for their supply of nitrogen upon nitrates and ammonia salts in the soil.

In forest trees the greatest proportion of nitrogen absorbed is retained by the leaves, this being one important reason for preventing the removal from the forest soil of decaying leaf matter and humus, which is rich in nitrogen.

Phosphorus occurs in proteid compounds; it is abundant in seeds, and, therefore, is particularly important for grain-producing crops such as wheat. It is absorbed from the soil in the form of phosphates, and is supplied in manures such as superphosphate and preparations made from bones.

Sulphur, though not occurring largely in proteids, is an essential constituent of protoplasm. It is absorbed from the soil in the form of sulphates.

Potassium, calcium, and magnesium are all necessary to plant life, though the part they play is not clearly understood. Potassium appears to be closely associated with the formation of carbohydrates from water and the carbon dioxide of the air, and if it is not present the fixation of carbon ceases. The occurrence of calcium in the form of calcium oxalate points to its serving to neutralise free oxalic acid which acts injuriously upon the living cells. These elements are absorbed chiefly as nitrates, sulphates, phosphates, and carbonates. Potassium carbonate left in the ash of plants is valuable as a manure.

Iron is found in plants only in very small quantities, but, since no chlorophyll can be formed without it, the nutrition of green plants is absolutely dependent upon its presence. Sufficient is contained in the seeds to provide for the needs of the first few leaves, but if the plants are then grown in solutions lacking in iron the succeeding leaves are pale and unable to fix carbon.

Numerous other elements occur in plants, some but rarely, others almost universally; in fact practically all the elements that occur in air, soil, and water have been found in plants.

Silicon is used by many cereals and grasses to strengthen the cell-walls, and occurs also in the wood of trees. It is obtained from soluble silicates.

Sodium and chlorine are of widespread occurrence; they are found most frequently as common salt, which in excess is injurious to plant growth.

Bromine and iodine are abundant in many marine plants, especially seaweed, which at one time was the principal source of iodides and bromides.

Manganese also is frequently found in plants, but little is known of its significance.

CHAPTER XVI.

Metabolism.

After the absorption of the various salts and elements, numerous chemical changes occur, which are generally referred to as metabolic processess or metabolism. Those constructive changes which result in the building-up of complex organic food compounds from simple salts and gases are termed constructive metabolism or anabolism, while those which lead to the formation of simpler compounds by decomposition of the more complex are termed destructive metabolism or catabolism. The products of metabolism are either plastic products, which can be further developed, or waste products, which are either excreted or deposited.

Anabolism.—Although roots obtain carbon compounds from the soil, it has been found from growth in water in which no carbon was present that the carbon dioxide of the air is the chief source of carbon supply upon which green plants must rely. As no organic food can be built up without carbon, the first step in the anabolic process of assimilation of food is the fixation of carbon.

Carbon Fixation or Photosynthesis.—Exactly what chemical action takes place when the carbon dioxide of the air enters the cells of the leaf is not known, but briefly it may be stated that the carbon dioxide dissolves in water, forming carbonic acid, which is continuously broken up by the action of sunlight on the living plant cells. Oxygen is set free, and very early in the processes of assimilation simple carbohydrates like sugar and starch are formed.

What actually takes place in the earlier stages of sugar formation is yet obscure, but it has been definitely established that, for chemical changes of this nature to take place, living plants must be exposed to a sufficient intensity of light and suitable temperatures, they must contain chloroplasts, and salts of potassium must be present in the sap.

The primary importance of exposure to light is that the rays of light furnish the energy necessary to cause the chemical change, the plant being unable to do this unaided.

The chloroplasts have associated with them the green colouring matter called chlorophyll, the function of which is to absorb certain of the rays of light whose energy is required. This energy is then utilised by the chloroplasts.

Given insufficient light, green plants are unable to build up carbohydrates from carbon dioxide and water, and plants such as fungi which do not possess chloroplasts have to obtain their organic food from other plants or organic material; also, the fixation of carbon is restricted to those parts of the plant which contain chloroplasts.

The fact that the fixing of carbon is dependent upon the action of light has lead to the term "photosynthesis" being coined to denote the process.

Formation of Proteids.—The formation of the first simple carbohydrates is the foundation of all later anabolic processes by means of which large numbers of food products and other organic compounds are built up by the plant. The most important of the more complex compounds are those containing nitrogen, such as the amides and the proteids.

As pointed out previously, the free nitrogen of the air cannot be extracted directly by the higher plants, except in the case of species belonging to the family Leguminosæ and a few other plants, and then only by virute of their association with bacteria in their roots. Even then, the bulk of the nitrogen utilised by them and, of course, the whole quantity required by other green plants must be absorbed from the soil in the form of chemical compounds.

Nitrogen occurs in the soil in organic compounds in ammonium salts and in the form of nitrates. The oxidising action of various soil influences and bacteria results in the nitrogenous soil compounds being converted finally into nitrates, this process being known as nitrification.

Nitrification is hastened by exposure to light and heat and by aeration, and consequently the removal of dense forest cover and the working of the soil greatly accelerates the decomposition of the forest humus and the formation of nitrates in comparative abundance; hence the growth of plants on cleared land, which has also been sweetened by burning, is especially vigorous, particularly so in the case of species which are said to be nitratophilous or nitrate-loving, as vigorous weeds like Thistle, Ink Weed, Wild Tobacco, &c., which spring up following a fresh burn.

In addition to nitrogen, sulphur, and phosphorous are two important constituents of proteids, these being obtained from the soil in the form of sulphates and phosphates.

The chemical changes which these compounds undergo in the plant are undetermined, the synthesis or creation by the union of their elements of proteids being very complex, but it is known that intermediate nitrogenous compounds, such as amides, are formed, and that these are ultimately combined with carbohydrates and other compounds to form proteids, this process taking place largely in the leaves.

Although light is necessary for the fixation of carbon by the leaves, the synthesis of proteid compounds proceeds without the influence of light, and hence, although leaves play the most important part in this work, thus ensuring the utilisation of the carbohydrates before there is an undue and possibly injurious accumulation thereof, similar work is performed by the roots and other parts of the plant.

Utilisation, Translocation, and Storage of Plant Foods.—Of the various organic compounds manufactured by the plant, some are oxidised and consumed in the process of respiration, but, since a growing plant increases in bulk, a greater proportion is used to build up new material than is lost owing to catabolic processes.

Just as special conducting tissue is developed in the xylem for the transference of mineral solutions from the roots to the leaves, so the plant has to arrange for the translocation of organic foods products from the cells in which they are manufactured to those parts of the plant in which development and growth is taking place.

Insoluble carbohydrates, such as starch and colloidal proteid substances, may not readily diffuse by osmosis through the cell-walls, and consequently they have to be decomposed into soluble diffusible compounds in order that osmosis from cell to cell make take place. Starch is converted into soluble sugar, and proteids, into diffusible amides, these products being later transformed back to the higher compounds

as required. Thus there is a continual building-up and breaking-down of the food products according as they are to be utilised by the protoplasm or transferred to other cells.

Just as the action of osmosis is not sufficiently rapid to account for the rapid rise of sap in a tree, so it is not adequate to maintain the supply of organic food, and consequently special conducting tissue, situated in the phloem and known as the sieve tubes (Plate 203), is provided for the conveyance over long distances of both diffusible and non-diffusible compounds. It is obvious, in fact, that the upward flow of sap in the tracheæ and tracheids of the xylem must preclude this tissue from being used as a channel for conduction downwards, and that the provision of additional channels elsewhere is essential.

Whereas the tracheal tissue is composed of dead cells, which are enabled by their association with living parenchymatous cells to maintain the transpiration current, the sieve tubes, on the contrary, are living organs containing protoplasm, and cease to function as conducting agents when dead. They are associated also with other living cells, such as companion cells and phloem parenchyma, which all play a part in the conduction of organic food, though in a manner as yet imperfectly understood.

The food current in the sieve tissue is drawn upon as required by adjacent tissue in the bast and cortex, while it is conveyed to the cambium and wood by the medullary rays, which form the connecting link between the wood and the bark.

The effect of breaking the continuity of the phloem or bast and checking the downward motion of the organic food by making a narrow cut through the bark of the branch of a tree is that the food supplies are retained in the branch above the cut, with the result that the shoots and fruit thereof grow more luxuriantly. This is sometimes made use of in fruit culture in order to obtain increased yields, the process being known as "ringing."

Not all of the food manufactured is used immediately in the building-up of new cells, and a considerable surplus is stored in various parts of the plant for future use. In the case of annuals, which die at the end of their growing season, the reserve food is accumulated wholly in the seeds for the use of the next generation, while in such vegetables as carrots and turnips the reserve is stored in the roots.

In the case of deciduous trees, the permanent storage of reserve supplies in the leaves would result in the loss by the trees of their reserve stores when the leaves fall in autumn, and consequently the reserve food of trees is to be found chiefly in the roots and the stem, the parenchyma of the cortex and the medullary rays being the principal tissues concerned therein. Supplies are stored in the leaves temporarily only.

The existence of reserve supplies in the roots enables them to live for some time after ringbarking, and to continue supplying the leaves with mineral food, and it is only when these supplies are exhausted that the roots die and the tree finally succumbs. In springtime the unfolding and initial growth of the buds of deciduous trees are dependent wholly upon the reserves stored by the tree during the previous season, while the coppice shoots which sometimes spring from the base of a ringbarked tree are nourished at first from the same source.

Since the reserve supplies from below must travel upwards in order to reach members at higher levels, the transpiration current is found to contain soluble organic food in addition to the mineral solutions previously referred to. Generally the mineral food in the sap occurs in far greater abundance than the organic material, but occasionally the sap is very rich in carbohydrates, a notable case being the Sugar Maple of Canada, the sap of which is a rich source of sugar.

Catabolism.—The catabolic processes carried on by the plant are mainly those which depend upon the absorption of oxygen, and result amongst other things in the formation of carbon dioxide, which is excreted as a waste product. A similar process is carried on in animals, and is known as respiration.

Respiration is as essential to the life of plants as to that of animals, though the process, except perhaps in the germinating seed, is much less rapid in the former than in the latter. The degree of activity of life depends upon the activity of the catabolic processes and respiration in particular, and if they cease life ceases also. Catabolism is, in fact, the source of energy which enables the anabolic processes to be carried on.

In all cases heat is produced during respiration, this being particularly noticeable in the case of warm-blooded animals. In plants, however, oxidation is less rapid and the rise in temperature is not generally noticeable, especially as it is compensated for by the cooling effect of transpiration. Germinating seeds respire very actively, and if heaped together the effects of respiration are not masked and the rise in temperature is plainly perceptible.

Respiration is thus the converse of carbon fixation, the former being a destructive and the latter a constructive process. In addition, respiration is not confined to the cells containing chloroplasts, but goes on in all living cells both in darkness and in light; also, not only green plants but all plants give off carbon dioxide, while only green plants have the power to fix the carbon of the atmosphere.

The free oxygen required by plants may be obtained directly from the atmosphere by the process of gaseous diffusion or may be absorbed in solution by the roots, the greater amount being obtained by the former method. Entrance to the intercellular spaces of the plant tissue is gained through the stomata and the lenticels.

Just as in the case of animals, plants quickly become unhealthy if not furnished with a sufficient supply of oxygen. Those parts of plants above ground naturally never suffer from want of oxygen, but the ill-effects of insufficient oxygen in the soil for the needs of the roots are frequently apparent.

Excess of water in waterlogged and badly-drained soils means that roots have to rely upon the insufficient supply of oxygen in solution, there being no free circulation of the air through the soil; hence the growth of trees and crops frequently found on such land is poor, while the aerial roots developed by some trees such as certain mangroves, which grow in tidal swamps, are an adaptation by means of which sufficient oxygen is obtained; also, seeds buried too deeply receive insufficient air and frequently do not germinate satisfactorily.

The dependance of vital activity on respiration is well illustrated by the vigorous respiration which is carried on by young, actively growing parts, and its almost complete absence in dormant buds and seeds.

Respiration in dormant seeds is so slight as to be almost unnoticeable, and in absolutely dry seeds and in dry mosses and lichens it is said to be absent altogether, this being the only case in which the stoppage of respiration is not accompanied by death.

Respiration is stimulated by higher temperatures—provided, of course, that the limit at which life is possible is not reached—while the addition of moisture to seeds promotes respiration; consequently, the germination of seeds requires suitable conditions of moisture and temperature, which vary with the species. Seeds may be dormant in the ground for many months on account either of lack of moisture or low temperatures, but when the combination of conditions is favourable rapid germination ensues.

Modern Work on Respiration.—Mr. W. D. Francis, Assistant Government Botanist, who has been in close touch with recent work on this subject, has kindly supplied the following note:—

"In recent years the chemistry of respiration has been closely investigated by Otto Warburg and his colleagues in Germany. According to Warburg, respiration in living cells is carried on by four complex organic compounds. These four complex substances are hæmin compounds which consist of iron, carbon, hydrogen, oxygen, and nitrogen. The principal reactive element in these four compounds is the iron contained in each of them. The four hæmin compounds form a chain. The oxygen consumed in cell respiration first unites with the iron of the first hæmin compound, which is thereby oxidised from the ferrous to the ferric state or from the lower to the higher state of oxidation. The oxygen then passes on to the next hæmin compound, and so on until it reaches the fourth. As the oxygen is transferred from the one compound to the other the iron of the first is automatically reduced and the iron of the second is oxidised, and so on. The oxygen transferred to the iron of the fourth hæmin compound does not appear to react directly with the materials which are usually oxidised to produce energy in the cell. Apparently Warburg considers that there are still one or more enzymes or ferments in the respiration process which require investigation, and these function between the fourth hæmin compound and the materials usually oxidised in the cell. The system of the four hæmin compounds has been found to be very widely distributed in the organic world, as, for instance, in bacteria, yeast, and higher animals. The first hæmin compound in the system is referred to as the oxygen-carrying enzyme. The last three hæmin compounds constitute cytochrome, which has been intensively studied in recent years by D. Keilin."

Enzymes.—Reference was made in the brief remarks dealing with the translocation of food products to the decomposition of higher solid or non-diffusible compounds to soluble products, the plants being able to bring about this transformation as required.

This transformation, which is a form of digestion, is due not only to the action of living protoplasm, but also to the chemical activity of substances known as unorganised ferments or enzymes; these substances are secreted by the protoplasm, and, since they remain unchanged during the chemical processes which they cause, are able to effect the transformation of large quantities of certain substances.

Some enzymes change the insoluble carbohydrates into various kinds of sugars, and some convert insoluble and indiffusible proteids into peptones and amides.

In addition to the enzymes, in these classes there are numerous others adapted to transforming the great variety of reserve products into different forms. One important enzyme, the use of which is of interest commercially, is zymase; this is present in yeast, and is largely used in breweries for the conversion of sugar into alcohol.

In certain cases the plant cells may secrete a peptonising enzyme which acts from without the absorbing tissues; this is found in some carnivorous or insectivorous plants. It occurs in the Sundews (*Drosera*), Pitcher Plants (*Nepenthes*), and perhaps others.

CHAPTER XVII.

Growth.

Influence of External Conditions.—The life of a plant varies very greatly with the species and the conditions under which it is growing. It may extend over a short period of a few months, as is the case with many annual garden and field plants, or may comprise hundreds and even thousands of years, as in the case of the giant Sequoias of California.

The principal conditions necessary for the healthy growth of plants are (1) a sufficient supply of water; (2) an adequate supply of the necessary food materials; (3) the presence of oxygen; (4) light; and (5) suitable temperatures.

Water.—More than half of the weight of green plants is free water, while water figures very largely in the chemical compounds of which the plant's substance is composed. In addition, large quantities are needed to convey the mineral salts from the roots to the leaves. The prime importance of water in plant growth is emphasised by the necessity for irrigation in dry areas and by a comparison of the rank growth in moist localities with the growth of dry and arid regions.

Food Materials.—The various elements necessary for the existence of plants have already been detailed, but if they are to be of use they must be present in a form capable of being dissolved by water. It happens not uncommonly that, owing to the insoluble condition of many of the compounds found in the soil, they are not available to the plant. The more rapid action of superphosphate of lime as compared with that of bone-dust is due to the fact that in the artificial preparation the manure is in a more soluble form, while the bone-dust is only rendered available by the slow action of soil influences.

Experiments have shown also that the growth of plants is not determined by the total quantity of food material which is in an available form, but by the quantity of the element present in the least amount. If the soil contains insufficient phosphates for the vigorous growth of a plant, then an abundance of nitrates and sulphates will be of no avail until the necessary phosphates have been added.

Oxygen is essential for respiration, as has already been emphasised, and well-aerated soils produce far better growth than those which are badly aerated. On the other hand, there are cases in which the soil can be too well aerated, as in very light sandy soils in dry climates. Under such conditions the free circulation of the atmosphere causes more rapid evaporation of soil moisture than is desirable, and also produces too rapid decomposition of decaying vegetable matter, thus causing the loss of the beneficial effects of humus.

Light.—The effect of light on plant growth is twofold. It is essential to the life of green plants in that without it the carbon in the air cannot be fixed by the leaves, but at the same time it exercises a retarding influence on the rate of growing parts.

If a healthy plant be transferred to a dark enclosure, it will be found to grow much more quickly than in the open, the cells formed being much more elongated and delicate. Such a plant is said to be etiolated, and if kept continually in darkness will remain alive only until the reserve food supplies have been exhausted.

Considerable variation exists in the light requirements of different species, some requiring full exposure to develop to the best degree, others requiring moderate shade, and some, such as certain ferns, requiring very deep shade even to grow at all, intense light being fatal to them. Some of the lowest organisms, such as certain of the bacteria, may be killed by even a few minutes' exposure to direct sunlight. The great majority of flowering plants, however, such as trees, shrubs, &c., are light-demanders, as previously explained, a sufficiency of light being essential to their very existence.

The necessity for a sufficiency of light may be seen in forests where the trees are growing thickly together; the lower branches of the trees, being too much shaded, have fallen off and died, this natural self-pruning resulting in the long, straight barrel prized by the timberman. Grown in the open, the lower branches of the same species persist, there often being no distinct central main trunk at all, or, when present, as in the Bunya and Hoop Pines, it may bear leafy branches from top to bottom.

Temperature.—The dependence of plant growth upon heat is clearly evident from the fact that in localities subject to cold winters the winter growth is very slow or may even cease altogether. This diminution in the rate of growth is much more marked in the native trees of colder latitudes and at higher elevations than in the greater part of Australia, where the winters are comparatively mild.

In connection with the effects of temperature on growth, consideration must be given to the temperature of the soil equally with that of the atmosphere, for if growth is to take place the temperature of the soil must be sufficient to enable the roots to perform their functions.

The ability of a plant or a portion thereof to withstand both high and low temperatures is greatly affected by the amount of moisture contained in the parts. In those parts of plants which are growing actively and are turgid the protoplasm may be killed when it reaches a temperature of 130 deg., whereas the protoplasm in many dry seeds is uninjured if they are placed in boiling water (*cf.*, the practice of soaking wattle seed in boiling water); also, dry seeds withstand much greater cold than do moist seeds, and spring frosts kill young, actively growing shoots, whereas more severe winter frosts do no damage to the drier, well-ripened shoots.

Young trees frequently start growth earlier in the growing season than old trees, because the absorbing roots of the former, being more in the surface soil, attain the temperature necessary for growth sooner than those lower down.

Growth in Height.—When germination first takes place, growth goes on in all parts of the seedling, the cells of which are in an embryonic

condition, but at an early stage in the life history growth in height or length becomes localised and confined to special parts of the plant, known as the growing points.

The growing point is usually at the apex of the shoot, but in grasses increase in the length of stems does not take place by growth at the apex, but is due to the activity of growing points which are situated at the base of the internodes, and which by their increase in length lift up the portions above them. Such growing points are said to be intercalary, and the result of such method of growth is, as is well known, that the tip of the grass is the oldest part, the younger and more succulent parts being lower down.

A similar method of growth occurs in the long leaves of some monocotyledonous plants, such as rushes, the actively growing part being at the base of the leaf, the tip being the oldest part and often quite dead and withered, while the base is still soft and succulent. The actively growing part of peduncles and pedicels of flowers is also often at the base. Intercalary growing points, however, are the exception, terminal growth being the rule.

The question often arises whether blazes and marks on trees, such as flood marks, are after a lapse of years practically at the same height from the ground as when first made, and a good deal of controversy has centred round the subject; all careful, accurate observations, however, go to show that there is not any, or practically speaking any, alteration in the height of such marks, thus going to prove that actual growth in length is confined to the terminal parts.

There is a considerable variation during each twenty-four hours, height growth at night being more rapid than during the day, this being due to the retarding influence of light on growth and to the fact that during the daytime the plant is engaged on the fixation of carbon and the formation of carbohydrates. At night-time the free utilisation of the manufactured food results in increased height growth.

Growth in Thickness.—The embryonic tissue which is responsible for the growth in thickness of the stem of a plant is the cambium or layer of thin-walled parenchymatous tissue encircling the stem and separating the phloem or bast from the xylem or wood. The cambium cells subdivide, producing new tissues on both sides, the inner forming new xylem, and the outer new phloem; thus the cambium is being continually pushed outwards by the new wood formed. Additional growth in thickness of the bark is due largely to the new tissues formed by the cork cambium, though the latter in many cases is compensated for in due course by the shedding of the outer layers of dead bark.

Growth Movements.—Inherent in the vital characteristics of protoplasm and plants is the power of movement in response to the influence of stimuli, such movements being a direct manifestation of the property of protoplasm known as irritability. The chief causes which produce movement in plant members are physical contact, changes in temperature, the force of gravitation, lateral illumination, and variation in moisture.

Contact.—Perhaps the most familiar example of movement induced by contact is that of the Sensitive Plants (*Mimosa* and *Neptunia*), whose bipinnate leaves immediately fold up when touched, the stimulus given by contact being transmitted through the pinnæ to the primary and secondary peticoles which accomplish the folding action.

Other examples are to be found in the tendrils of climbing plants, which on making contact with a foreign body are so stimulated that they curve towards and around the object, completely encircling it. Continued contact causes the tendril to become more turgid on the side not irritated, with the result that growth on the outside is more rapid, and the necessary curvature produced.

On the other hand, a very restricted area near the tips of growing roots is so affected by contact with stones and other impenetrable bodies that the roots curve away from the object, and thus enable themselves to continue growth in the direction in which food supplies can be obtained.

Changes in Temperature and Light.—In the well-known sleep movements of the leaves in trees—as in the pinnate-leaved Leguminosæ (*Albizzia, Acacia, Poinciana* spp., &c.)—during night the leaflets fold over one another so that only the edge of each leaflet remains exposed, and the same position may be assumed during the daytime, due to great heat or intense light; the folding in these cases accomplishes a twofold object—viz., to prevent the loss of heat by radiation during the night-time and loss of water vapour by transpiration during the hotter part of the day. In the case of floral leaves, these may open with bright, dry sunshine and close at night, this being particularly noticeable in some Compositæ such as Everlastings, Sunflowers, Gerberas, &c., or bright sunlight may cause the closure of the floral envelop, the parts opening out to their fullest during the night, as in the Moon Flower (*Ipomæa bona-nox*) and certain Cacti; in other cases flowers may be only open for a limited period during the day, as in the Morning Glory (*Ipomæa purpurea*), Fringed Violet (*Thysanotus*), *Sida retusa*, &c.

Lateral Illumination.—A plant allowed to grow in a room before a window, plants growing alongside a fence, a wall, &c., or the leading shoot of a tree growing close under the shelter of an overhanging tree, will be found to curve towards the side from which most light is received.

Moisture Variation.—Movements due to the influence of moisture are especially characteristic of roots of land plants, which always bend away from dry to moist soil. This property is so marked in roots that it may overcome their tendency to grow downwards, and by a suitable arrangement of moisture conditions they may be induced to grow upwards away from the centre of the earth.

The trunks of trees growing on the banks of watercourses or along the edges of fresh-water pools often have a marked tendency to lean over towards the water, due to the greater root growth in the side nearer the water and the consequent pull exerted.

CHAPTER XVIII.

Reproduction.

In the previous five chapters the physiological processes described have been concerned with the maintenance of the life of the individual, and attention is now directed to the process of reproduction or the power of giving rise to new individuals. Among plants two distinct types of reproduction are recognised—(*a*) the vegetative or asexual, and (*b*) the sexual.

(*a*) *Vegetative Reproduction.*—In the lowest forms of plant life, such as the bacteria and unicellular Algæ, reproduction may merely consist of cell division, the parent plant dividing, the division being perhaps repeated several times, and the parts so divided separating off and starting life as new individuals, nothing being left of the parent as an individual plant. It is the higher plants, however, with which we are mainly concerned, reproduction in these implying the separation, either naturally or artificially, of vegetative portions of the parent plant and their subsequent development into new and complete individuals.

In a natural state vegetative reproduction is more or less restricted to herbaceous plants. It may occur by means of *rhizomes*, as in several grasses (*e.g.*, Couch Grass, Johnson Grass, &c.), stolons or runners, as in the Strawberry, bulbs or bulbils, as in the Lily, corms, as in Gladiolus, tubers, as in the Potato, by aerial tubers, as in the Yams (*Dioscorea* spp.), simply by leaves dropping on the ground, as in *Bryophyllum*, or by the cladodes, as in Prickly-pear (*Opuntia* spp.), by buds or young plantlets, as in many ferns (*e.g.*, *Asplenium attenuatum*, *A. bulbiferum*), &c.

Vegetative reproduction enters very largely into horticultural practice, all the above means being taken advantage of. In addition, plants are extensively propagated by means of cuttings and layers and by the well-known processes of budding and grafting so extensively used by gardeners and nurserymen.

(*b*) *Sexual Reproduction.*—Vegetative reproduction is a comparatively simple process in the higher plants mainly depending on the formation of adventitious roots; in contradistinction to this, sexual reproduction is a complicated process.

The characteristic feature of reproduction of new individuals by sexual means in either plants or animals consists of the union of two special kinds of cells known respectively as the male gamete and female gamete. In the flowering plants the fusion of the male and female gametes results in the formation of seed; so it can easily be seen that in the natural state reproduction by the sexual method is easily the more important among the higher plants.

The process which results in the union of the male and female gametes is spoken of as the process of fertilisation. The sexual organs of the plant are contained in the flower, and their external features and general characters have already been dealt with ("Morphology," Chapter VI.).

We will now follow the process which results in the fertilisation of the ovule and the consequent formation of the seed containing the embryo or young plant.

Pollination.—In order that the ovule may become fertilised, the pollen grains must be transferred from the anthers to the stigma, the surface of which is generally moist with a slight sticky secretion which serves the obvious purpose of retaining the pollen grains when they fall on it. The transference of the pollen grains to the stigma is called pollination.

Flowers are said to be self-pollinated when the stigma receives pollen from the anthers of the same flower, or cross-polinated when the stigma receives pollen from the anther of another flower either growing on the same or on a distinct plant. Similarly, when the act of pollination is

followed by the fertilization of the pistil, the flower is said to be self- or cross-fertilized, as the case may be.

Cross-fertilization.—Cross-fertilization, however, even in plants possessing hermaphrodite flowers, would seem to be the rule, and many obvious devices can be noticed for the effective carrying-out of cross and the prevention of self-fertilization.

It has also been proved by careful experiment that, as a general rule, seeds developed as the result of cross-fertilization give rise to plants which are more virile and vigorous in growth than do seeds developed as the result of self-fertilization.

In trees such as the Pines and She-oaks, in which the individual flowers bear either only male or female reproductive organs respectively, cross-fertilization is obviously ensured. On the other hand, looking at an ordinary hermaphrodite flower, it would seem that self-fertilization must be the rule, as the anthers and stigma lie in such close proximity. On going further into the matter, however, we find that self-fertilization is either completely prevented or more or less retarded by one or two simple methods.

Plants may produce hermaphrodite flowers of which the male and female organs of each individual flower do not ripen together; either the anthers mature and shed their pollen before the stigma is receptive, or the stigma is receptive or fit to receive pollen before the anthers dehisce. Self-fertilization may also be more or less prevented by the relative positions of the anthers and stigma in the same flower or by the anthers shedding their pollen outwards.

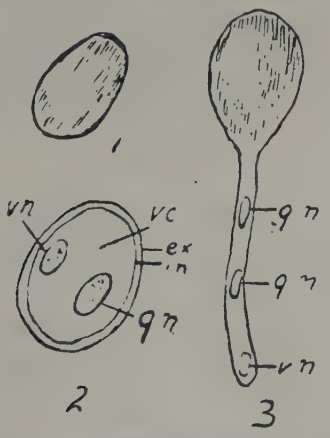


Plate 261.

1. Pollen-grain. 2. Section through a pollen-grain. 3. Germinating pollen-grain (diagrammatic).

Transference of Pollen.—In cross-pollination the pollen must be carried from one flower to another by some external agency, and the principal agencies employed by plants in this work are the wind, insects, and birds. Wind-pollinated flowers are usually inconspicuous, scentless, and produce no sweet nectar for the purpose of attracting insect or bird visitors. The pollen is usually dry and produced in great abundance, as in the Pines, and the stigmas may be relatively large and feathery, as in grasses, and thus especially adapted to catch the floating

pollen grains. Plants with wind-pollinated flowers are often gregarious in their distribution, as in many Conifers (*e.g.*, the Hoop and Bunya Pines, &c.), the *Casuarinaceæ* (She-oaks), grasses, &c.

Sometimes the flowers may be pollinated by almost any visitor—insect or bird—but there are many flowers which are especially adapted for pollination by a particular group of insects or birds, or even by one particular species of either. These flowers possess, as a rule, brightly coloured floral leaves, are often scented, and secrete nectar by means of their nectaries or honey glands. To what extent insect and bird visitors are attracted by the two first-mentioned properties is a matter of some doubt, but there is no doubt whatever that the pollen and nectar are the principal attraction for pollen-eating insects and nectar-feeding insects and birds.

Fertilization.—Though flowers are spoken of as either cross-pollinated or cross-fertilized, it must be clearly understood that pollination and fertilization are two very distinct processes. Pollination is merely the dusting of the stigmatic surface with pollen. Fertilization is the actual fusion of the male and female cells.

In its younger stage the pollen grain is unicellular, but later the cytoplasm and nucleus divide and a small cell is produced lying in the general protoplasm; this is the generative cell or male reproductive cell (Plate 261—2, *g.n.*), and the larger one in which it lies is now differentiated as the vegetative cell (Plate 261—2, *v.c.*), and its nucleus as the vegetative nucleus (Plate 261—2, *v.n.*). The pollen grain now really appears as a large cell with two nuclei lying in it. When a ripe pollen grain is placed on the moist stigma of a suitable flower, it germinates; its outer crust is ruptured and a long delicate tube is sent out—the pollen tube (Plate 261—3)—which penetrates the stigmatic surface and grows down through the style towards the ovary. During this process the generative cell and the vegetative nucleus travel into the pollen tube, the vegetative nucleus becomes disorganised and eventually disappears, but the generative or male reproductive cell divides into two.

A typical pollen grain possesses two coats—an outer, comparatively stout one, known as the extine (Plate 261—2, *ex.*) (this is commonly marked with veins, striations, or wartlike processes), and a thinner inner coat, known as the intine (Plate 261—2, *in.*).

Development of the Ovule.—The main characteristic features of the ovule have already been described. At an early stage in its development a large cell termed the embryo-sac (Plate 262, *e.s.*) makes its appearance in the tissue of the nucellus (Plate 262, *nu.*) near the micropyle.

A number of daughter cells are now produced within the embryo-sac, the process being somewhat as follows:—

At first the embryo-sac has the appearance of an ordinary cell with a single nucleus lying somewhere about the centre of the cytoplasm, but before fertilisation takes place the nucleus divides into two, the two daughter-nuclei passing to the opposite ends of the cell; here each by further division gives rise to four separate nuclei, so that at this stage there are eight free nuclei in the embryo-sac. After this one nucleus from each group travels back to the centre, where they fuse with each other to form what is known as the secondary (or definite) nucleus (Plate 262, *n.*) of the embryo-sac.

The other nuclei now receive differential names. The three situated near the chalaza develop cell-walls and are known as the antipodal cells (Plate 262, *a.*). The three situated near the micropyle do not become surrounded by cell-walls and constitute the so-called egg-apparatus; two of the cells of the egg-apparatus are termed synergidæ (Plate 262, *s.*), the third being variously known as the ovum, egg-cell, or oosphere (Plate 262, *o.*). The ovum is the actual female reproductive cell, and its consequent fusion with the generative or male reproductive cell from the pollen grain is the act of fertilisation which results in the formation of the seed and eventually a new plant. How this fusion is brought about will now be described.

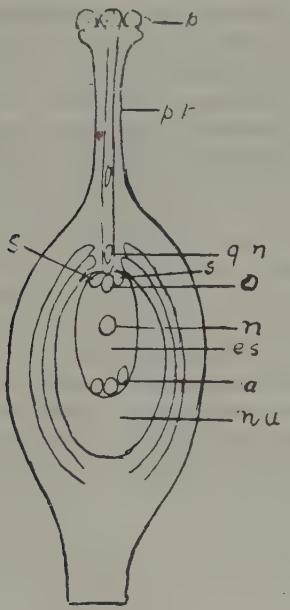


Plate 262.

Longitudinal section (diagrammatic) through a carpel containing a single orthotropous ovule.

After the germination of the pollen grain the pollen tube advances through the tissues of the style and ovary, and at length reaches an ovule, which it penetrates through the micropyle and comes into contact with the egg-apparatus. At this stage its tip becomes disorganised, and one of the generative cells escapes and unites with the ovum or egg-cell; this fusion is the essential feature of the act of fertilization. The fertilized ovum forms a cell-wall and is now termed an oospore. A cell resulting from the fusion of two gametes, as the fertilized egg-cell of the ovule, is termed a zygote. In flowering plants the zygote or oospore develops into an embryo and thence finally into a new individual plant.

Effects of Fertilization.—Fertilization not only results in the development of the embryo and seed, but the growth of the whole ovary is stimulated, resulting in the formation of the fruit, and in most cases, unless fertilization takes place, fruits either do not develop at all or fall off long before they reach anything like normal size. Sometimes, in

addition to the ovary, other parts of the flower are stimulated into increased growth, as the perianth tube in *Eugenia* and *Cryptocaraya*, the pedicel in *Exocarpus*, the torus in the Apple, &c.

Though, as a general rule, non-fertilization is followed either by the more or less immediate withering and shedding of the whole flower or later of the immature fruit, some notable exceptions to this rule are known among cultivated plants, such as the Banana, Pineapple, Navel Orange, the seedless Currant and Sultana Grapes, &c., all of which almost invariably produce seedless fruits. The cause of seedlessness in all cases is not known.

The common edible Fig (*Ficus carica*) is an example of a cultivated fruit in which, in some varieties only, development is continued without fertilization of the ovules taking place. A brief account of the structure of a fig fruit will be found under Plate 171. Of the common edible fig there are four distinct kinds or races—viz., (1) Caprifigs, which bear male, female, and gall flowers; these trees occur wild in the Mediterranean region and have been introduced into other fig-growing countries as Australia, California, (2) Smyrna figs, a race that develops female flowers only, but which will not develop fully formed fruit unless pollinated by pollen from the males, borne on a caprifig; pollination is carried out by a small wasp (*Blastophaga grossorum*). Smyrna figs are largely grown for drying purposes, the ripened achenes or nutlets (seeds) giving the fruit a nutty flavour. (3) The common edible fig, grown largely in Australia and elsewhere; the fruit does not require fertilization of the female flowers to become fully formed. Ripe seeds, however, are not produced; hence the fruit when dried lacks the nutty flavour of the Smyrna type. (4) A race known as the San Pedro figs, in which one crop is of figs that develop without fertilization of the female flowers; this is succeeded by a second crop in which the fruits fall off before reaching maturity unless fertilization from the oollen of a caprifig has been carried out. In countries where Smyrna figs are grown branches of the caprifig bearing receptacles are hung up in the branches of the fruit-bearing sorts, the process being known as *caprification*.

Though unfertilized flowers soon drop off the plant, it does not follow that all fertilized ones persist and that their ovaries develop into mature fruit; this is especially true of plants that produce a great wealth of blossom, and it is doubtful in such cases if the plant could support the weight of fruit and withstand the drain on its system consequent upon all the flowers developing mature fruits; on the other hand, in plants which produce only a few flowers nearly every fertilised flower may result in a fully developed fruit.

Every ovule requires a pollen grain to effect fertilization if it is to develop into a seed, so that in fruits closely packed with numerous seeds, such as the watermelon, papaw, passion fruit, &c., a great number of pollen grains must be placed on the stigma. In the case of the watermelon, which may produce several hundred fully developed seeds in a single fruit, it has been estimated that over a thousand pollen grains must fall on the receptive stigma.

[TO BE CONTINUED.]

The Babcock Test.

L. A. BURGESS, A.A.C.I., Dairy Research Laboratory, Dairy Branch.

HISTORICAL.

VERY early in the organisation of the dairying industry it was decided that milk and cream should be paid for on the percentage of fat which it contained.

For this purpose a method which was cheap, quick and accurate was required, and the first method fulfilling these conditions was that of Gustaf De Laval, who, in 1885, took out a patent in Sweden for the use of a mixture of twenty parts of acetic acid and one part of sulphuric acid. This mixture coagulates and then dissolves the proteins and destroys the emulsion, and a brief whirling in a centrifugal causes the fat to collect in a clear, sharply defined layer.

This method was followed in 1889 by the Leffman and Beam method. The bottles used are very similar to the familiar Babcock bottles but smaller, and the basis of graduation is different and the zero mark is at the top of the bottle. The method is as follows:—

Measure 15 ml. of milk into the test bottle. Add 3 ml. of a mixture of equal volume of amyl alchohol and hydrochloric acid and mix. Add 9 ml. of sulphuric acid and mix. Fill the bottle to the zero mark (top of the graduations) with dilute sulphuric acid (one part of acid plus two parts of water) and place in the centrifuge and whirl for one minute.

The percentage of fat is read from the bottom of the lower meniscus to the bottom of the upper meniscus.

About the same time as Leffmann and Beam introduced their method, Dr. S. M. Babcock, of the Wisconsin Agricultural Experiment Station, was working out the method now known as the Babcock method. This was introduced in 1890 in a pamphlet entitled "A New Method for the Estimation of Fat in Milk especially adapted to Creameries and Cheese Factories." This method immediately became popular, as the only chemical required is sulphuric acid.

Later still, Gerber modified the Leffmann and Beam method by eliminating the hydrochloric acid and adapting it to yet another method known as the Marchand method, and the resulting method known as the Gerber method is almost universally used in European countries. This method utilises a special form of bottle known as an "acido-butyrometer" as well as a specially designed centrifugal machine holding a large number of bottles.

The method is carried out as follows:—

Measure ten ml. of sulphuric acid into the empty bottles, then add eleven ml. of milk and one ml. of amyl alcohol. A rubber cork is then inserted and the contents shaken until the curd is dissolved. The bottle is then inserted in the holes of the centrifuge, whirled for two or three minutes, and the percentage of fat read off from the bottom of the bottom meniscus to the bottom of the upper maniscus.

Of all these methods the Babcock method is probably the most widely used, although it is not quite so fast as the Gerber or Leffman and Beam methods.

THEORETICAL DISCUSSION OF THE BABCOCK METHOD.

Milk and cream are composed of fat and serum. The serum consists of water in which is dissolved lactose, mineral salts, and albumin, and this aqueous solution is intimately mixed with casein, forming an excellent emulsion in which the fat is distributed in the form of very minute globules. If this emulsion is destroyed these fat globules may be collected in a mass, and the volume occupied by the fat may then be measured.

The means employed for the destruction of the emulsion and for the collection of the fat globules are:—

1. Sulphuric acid, which dissolves the casein, thus destroying the emulsion.
2. Heat generated by the action of the sulphuric acid on the water of the milk serum. This generated heat melts all the fat and keeps it in a fluid and mobile condition.
3. Centrifugal force, which assists the accumulation of the fat. The effect of centrifugal force may be illustrated by placing two bodies of the same shape and size, but of differing weights, such as a cork and a piece of lead, near the centre of a revolving platform. Each of these bodies is flung outwards and each of them will be travelling at the same speed when they reach the edge of the platform. The heavier body, however, will have the greater momentum and will be flung further than the lighter body.

In the Babcock test the two bodies are:—

1. The fat, which is much the lighter body,
2. The acid serum mixture, which is very much heavier.

As the cups of the centrifuge limit the distance to which these two bodies may be flung, the heavier acid serum accumulates as far as possible from the centre of rotation, and forces the much lighter fat nearer the centre. The water which is added during the test serves the dual purposes of:—

1. Washing the fat layer free from acid serum.
2. Forcing the fat nearer and nearer to the centre of rotation until the final whirling brings the washed fat into the graduated neck of the test bottle, where the volume of fat may be measured.

The graduations on the neck of the test bottles bear a definite relationship to the volume and weight of the fat, and to the volume and weight of the milk originally introduced into the bottle. This relationship is based on the average specific gravity of milk fat at 140 degrees Fahr. being 0·900. The volume of the graduated neck between 0 and the 8 per cent. mark is 1·6 Ml., each 1 per cent. graduation therefore representing 0·2 ml. Now 1·6 ml. of butter fat at 140 degrees Fahr. having the specific gravity of 0·900 (*i.e.*, a known volume of fat weighs only 0·900 times as much as the same volume of water) weighs only

$$1{\cdot}6 \times 0{\cdot}900 = 1.44 \text{ gram.}$$

This 1·44 gram of fat represents 8 per cent. by weight of fat, the weight of milk for which the bottle is graduated is therefore

$$1{\cdot}44 \times \frac{100}{8} = 18{\cdot}00 \text{ grams.}$$

Now 18 grams of milk at 70 degrees Fahr. (milk having a specific gravity of 1·03, *i.e.*, a known volume weighs 1·03 times as much as the same volume of water) occupies a volume of

$$\frac{18}{1{\cdot}03} = 17.48 \text{ ml. or very nearly } 17.5 \text{ ml.}$$

A pipette with a total volume of 17·6 ml. will deliver only 17·5 ml. under ordinary conditions of usage, the remaining 0·1 ml. clinging to the inside walls of the pipette.

The whole calculation can be reversed by starting from the pipette having a total volume of 17·6 ml. as follows:—

A 17·6 ml. pipette delivers 17·5 ml. of milk.

17·5 ml. of milk weighs 17·5 x 1·03 = 18 grams.

$$8 \text{ per cent. of } 18 \text{ grams} = \frac{8 \times 18}{100} = 1{\cdot}44 \text{ grams.}$$

$$1{\cdot}44 \text{ gram. of fat occupies } \frac{1{\cdot}44}{{\cdot}900} = 1{\cdot}6 \text{ ml.}$$

The 0 to 8 per cent. graduations of the bottle therefore show a volume of 1·6 ml.

On the cream test bottles the graduations are based on only 9 grams of cream being used, the volume represented by each 1 per cent. graduation being therefore only half that of the milk bottle graduations. Each 1 per cent. graduation therefore represents 0·1 ml., and the whole of the 50 per cent. graduations represent a volume of 5·0 ml.

As cream has a variable specific gravity varying from about 0·950 for a 50 per cent. cream to 1·002 for a 25 per cent. cream, the 8·8 ml. of cream used in the testing of cream does not represent 9 grams. With the two cases mentioned the weights of cream taken are—

8·8 x ·950 = 8·36 grams for the 50 per cent. cream,

and 8·8 x 1·002 = 8·82 grams for the 25 per cent. cream.

The percentage of fat obtained by the cream test is therefore lower than the true percentage.

O'Callaghan gives figures showing that a 48·5 per cent. test = 50·9 per cent. true fat and 38 per cent. test = 39·4 per cent. true fat.

Accurate results when testing cream are therefore only obtainable by weighing 9 grams of cream into the test bottle.

The commercial butter tables used in Queensland, however, are based on the readings obtaining by using 8·8 ml. of cream, allowance having been made for the inherent inaccuracy of the method.

TAKING THE SAMPLE.

(*a*) *Sampling of Bulk Supplies.*

When testing a sample of a bulk supply, the small sample taken must represent the average quality of the whole. The bulk must, therefore, be as well mixed as possible prior to drawing the sample for analysis, by stirring well with a long paddle or a specially constructed stirring rod with a shallow dish attached to the end. When

the bulk is as homogenous as it is possible to make it by these means the sample should be immediately drawn and placed in a separate small receptacle which must bear some distinguishing mark, such as a number, so that the various patrons' samples will not be hopelessly mixed.

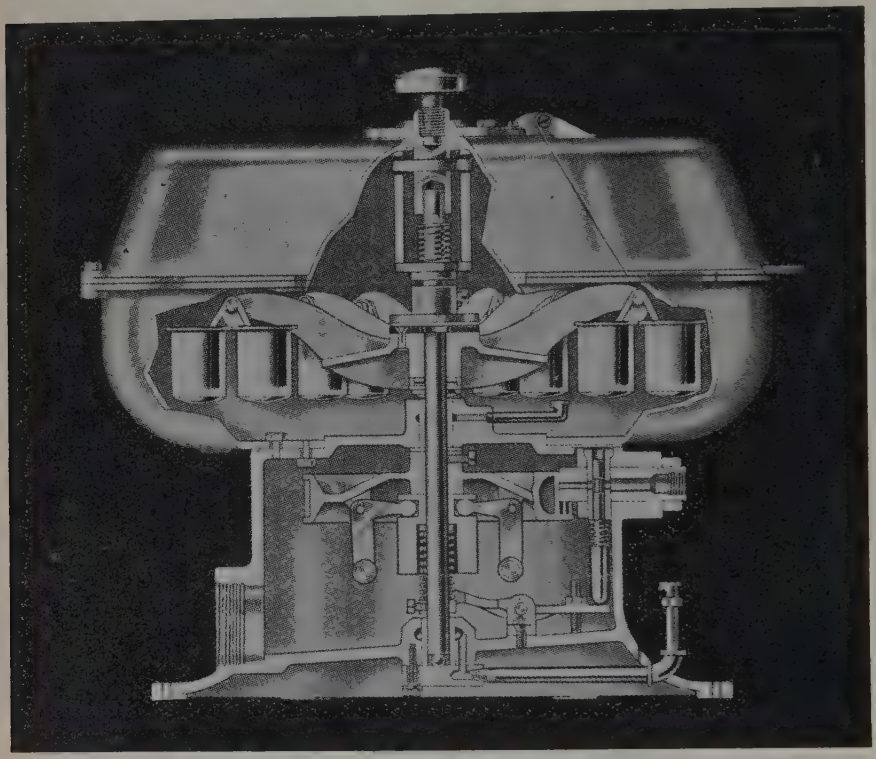


Plate 263.

Cross-section of a modern steam turbine Babcock "tester" with a built-in governor.

The practice in butter factories is to place the samples of cream in small cups or mugs, and these are taken to the testing room and tested almost immediately. When a sample is to be kept for any length of time it should be placed in a jar or bottle with a well-fitting stopper to prevent evaporation.

(*b*) *Composite Samples.*

In cheese factories composite samples of each patrons' supply are kept and analysed periodically, generally weekly. To do this the sample must be preserved.

The preservatives used are:—

1. Formalin or formaldehyde.
2. Corrosive sublimate or mercuric chloride.
3. Potassium dichromate.

Formalin is the most commonly used preservative in Queensland, and has proved very satisfactory for the purpose.

The composite samples are obtained by taking a small amount of each day's supply and storing in a bottle containing the preservative. Mixing the contents of the bottle after each day's sample has been added is essential.

THERE IS ONLY ONE BABCOCK TEST.

Regulations 157 and 161 under "*The Dairy Produce Acts*, 1920 *to* 1935," provide that milk and cream shall be tested by the Babcock method or other method approved by the Minister.

It is very important, therefore, that the standard technique of the Babcock method be faithfully followed. Any modification introduced to hasten the testing automatically makes the method illegal, as none of the modifications usually practised are approved.

THE TESTING OF MILK.

Reagent.

Commercial Sulphuric acid—Specific gravity, 1·82 to 1·83 at 70 deg. Fahr.

Apparatus.

(*a*) *Test Bottle.*—The 8 per cent., 18-gram milk test bottle specifications for which are given in Regulation 190 under the Dairy Produce Acts.

(*b*) *Pipette.*—The 17·6 ml. pipette specified in Regulation 192 under the Dairy Produce Acts.

(*c*) *Acid Measure.*—Any suitable device to measure 17·5 ml. of sulphuric acid.

(*d*) *Centrifuge or "Tester."*—The standard centrifuge, however driven, shall be constructed throughout and so mounted as to be capable, when filled to capacity, of rotating at the necessary speed with a minimum of vibration and without liability of causing injury or accident. The proper rate of rotation may be ascertained by reference to the table below. By "diameter of wheel" is meant the distance between the inside bottoms of opposite cups measured through the centre of rotation of the centrifuge wheel while the cups are horizontally extended.

Diameter of wheel in inches ..	12, 14, 16, 18, 20, 22, 24
Revolutions per minute ..	980, 909, 848, 800, 759, 724, 693

It shall be heated, electrically or otherwise, to a temperature of at least 130 deg. Fahr. during the whirling.

(*e*) *Dividers or Callipers.*—For measuring the fat column.

(*f*) *Water Bath.*—Provided with a thermometer and a device for maintaining a temperature of 130 deg. to 140 deg. Fahr. The bath shall be of such depth that the test bottles may be immersed to the top of the graduations.

Preparation of the Sample for Analysis.

If the sample is fresh or in a good homogeneous condition, the only preparation required is to bring the sample to a temperature of between 60 deg. and 70 deg. Fahr., and mixing well just prior to testing.

If the sample is partly churned, the sample bottle should be placed in warm water until the churned fat is well softened, then well mixed and cooled to 60 deg. to 70 deg. Fahr. with frequent gentle mixing. The fat should never be melted to an oil as it is then difficult to again incorporate into the sample.

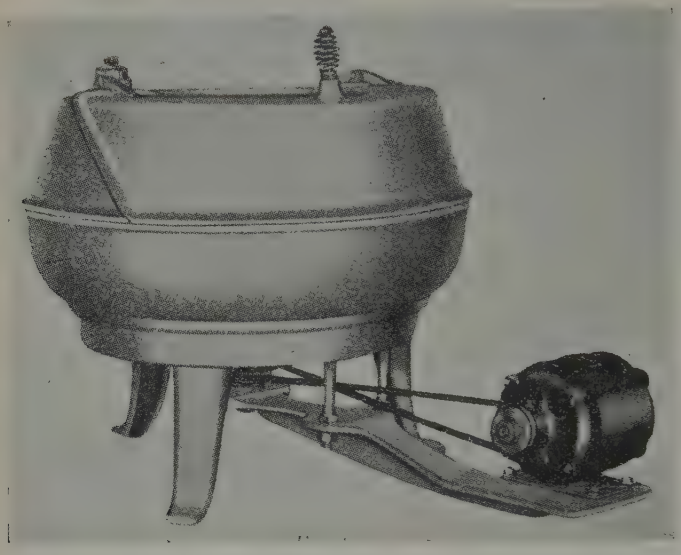


Plate 264.
Belt-driven electric Babcock "tester."

If the sample is curdled, a small amount of powdered caustic soda may be added (about 1 gram for a ½-pint sample) and the sample well mixed until the curd has redissolved. When a sample is so treated, greater care must be used when mixing acid with the milk, as much greater heat is generated.

One of the best methods of mixing samples is to pour from one vessel to another, allowing the milk to run down the walls of the vessels. In this way solid lumps can be easily seen, churning is practically prevented, and no air is mixed with the sample.

Determination.

Insert the lower end of the 17·6 ml. pipette into the prepared sample and fill to some distance above the mark by applying suction to the upper end. Quickly cover the top of the pipette with the tip of the finger, and *adjust the bottom of the meniscus to the graduation mark* by lessening the pressure of the finger sufficiently to allow air to slowly enter the top of the pipette. To do this with the required accuracy, the pipette must be held vertically with the graduation mark at eye level. A pipette should never be used in any other manner.

Drain the milk in the pipette into the test bottle and blow out the last drop. The test bottle should be marked to correspond with the mark on the sample container.

Add 17·5 ml. of the sulphuric acid. The temperature of the acid should be between 60 deg. and 70 deg. Fahr., and should be added in

such a manner that it flows down the walls of the neck and the bulb forming a layer beneath the milk, and, incidentally, washing down any drops of milk from the neck.

Immediately mix the acid and milk by shaking with a rotary motion. This rotary motion prevents splashing into the neck of the bottle. The mixing should be continued until all traces of curd have been dissolved and the mixture turns a dark chocolate colour. With preserved samples, the curd is much harder to dissolve, and, with very obstinate cases, the bottles may have to be placed in water kept at 130 deg. to 140 deg. Fahr. with constant shaking until the curd has dissolved.

Place the bottles in the cups of the tester, seeing that the wheel is evenly balanced. If an odd number of samples are being tested, test one sample in duplicate, as this will make an even number of bottles and will also indicate whether the technique gives constant results.

Whirl for five minutes after the correct speed has been attained.

Add hot soft water to the bottles until the bulb is completely filled. The temperature of the water should be between 140 deg. and 160 deg. Fahr. If soft water is not available, it is advisable to add a few drops of sulphuric acid to each pint of cold water and heat the very slightly acid water to the required temperature.

Whirl again for two minutes.

Add hot water until the level of the liquid approximately reaches the top graduation mark.

Whirl again for one minute.

Place the bottles in the water bath which should previously have been heated to 130 deg. to 140 deg. Fahr., and allow them to remain with the whole of the fat column immersed for five minutes so that the fat will attain this temperature before measuring.

Reading the Percentage of Fat.

By means of the dividers, which should have fine, sharp points, measure the entire length of the fat column. This is best done by placing one point of the dividers on the lowest point of the lower meniscus and then adjusting the other point to the top of the upper meniscus of the fat column. Without altering the adjustment of the dividers, place one point on the zero mark and the mark which the other point reaches is recorded as the percentage of fat by weight.

The fat column at the time of reading the percentage should be translucent, of a golden yellow or amber colour, and free from visible suspended matter, gas bubbles, or charred matter.

THE TESTING OF CREAM.

Reagent.

Commercial Sulphuric Acid—Specific gravity, 1·82 to 1·83 at 70 deg. Fahr.

Apparatus.

(*a*) *Test Bottle.*—The 50 per cent., 9-gram cream test bottle specified in Regulation 191 under the Dairy Produce Acts.

(*b*) *Pipette.*—The 8·8 ml. pipette specified in Regulation 193 under the Dairy Produce Acts.

The other apparatus required is the same as that described for the testing of milk.

Preparation of the Sample for Analysis.

As cream is much more difficult to mix than milk owing to its greater viscosity, the samples of cream are warmed gently until they are liquid enough to be thoroughly mixed and to be easily drawn into the pipette. The sample shall not, however, be heated to a higher temperature than 80 deg. Fahr. The other remarks made about milk samples also apply to cream.

Determination.

Insert the lower end of the 8·8 ml. pipette into the prepared sample and fill to some distance above the graduation mark by applying suction to the upper end. Quickly cover the top of the pipette with the finger, hold the pipette in a vertical position at eye level, and *adjust the bottom of the meniscus to the graduation mark.*

Drain the remaining contents of the pipette into the test bottle

Insert the lower end of the used pipette into warm water (110 to 120 deg. Fahr.) and fill to approximately the position of the graduation mark.

Wash down the walls of the neck of the test bottle by means of about one-half of the contents of the pipette.

Now close the lower end of the pipette with the finger and shake the pipette until all the cream has been loosened from the sides.

Drain the remaining contents of the pipette into the test bottle and blow out the last drop.

Add from 12·5 ml. to 17·5 ml. of sulphuric acid, the actual amount to use being best judged by the colour which develops in the bottle, the desirable colour being chocolate darkening more slowly than is the case with milk. If the cream is very rich in fat, less acid will be required than if the cream is poor in fat.

Place the bottles in the cups of the tester, seeing that the wheel is evenly balanced. If an odd number of samples are being tested, test one sample in duplicate, as this will make an even number of bottles and will also indicate whether the technique gives constant results.

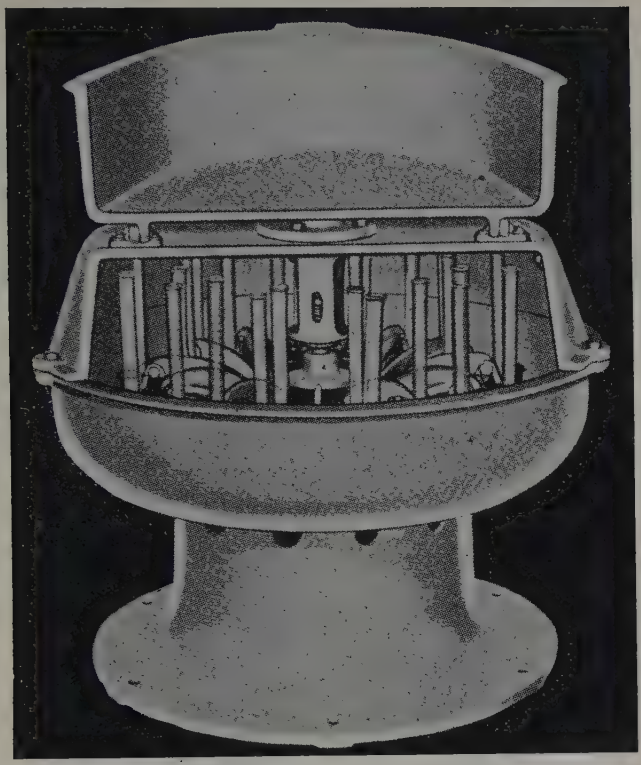
Whirl for five minutes after the correct speed has been attained.

Add hot soft water to the bottles until the bulb is completely filled. The temperature of the water should be between 140 deg and 160 deg Fahr. If soft water is not available, it is advisable to add a few drops of sulphuric acid to each pint of cold water and heat the very slightly acid water to the required temperature.

Whirl again for two minutes.

Add hot water until the level of the liquid approximately reaches the top graduation mark.

Whirl again for one minute.



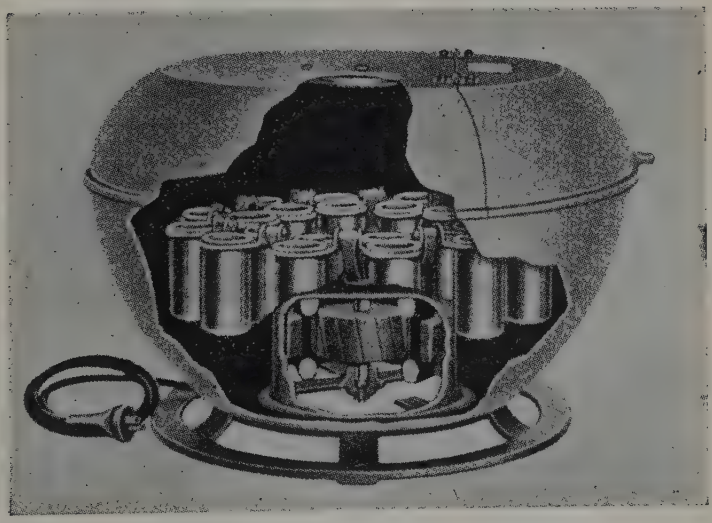


Plate 265.
Direct drive electric Babcock "testers."

Place the bottles in the water bath, which should previously have been heated to 130 deg. to 140 deg. Fahr., and allow them to remain with the whole of the fat column immersed for five minutes.

Reading the Percentage of Fat.

By means of the dividers, which should have fine, sharp points, measure the entire length of the fat column. This is best done by placing one point of the dividers on the *extreme lower end* of the fat column and then adjusting the other point to the *extreme upper end* of the fat column. Without altering the adjustment of the dividers, place one point on the zero mark and the mark which the other point reaches is recorded as the percentage of fat.

This method of reading the fat column is given in Regulation 157 under the Dairy Produce Acts, and is the only method allowed.

The fat column at the time of reading the percentage should be translucent, of a golden yellow or amber colour and free from visible suspended matter, gas bubbles, or charred matter.

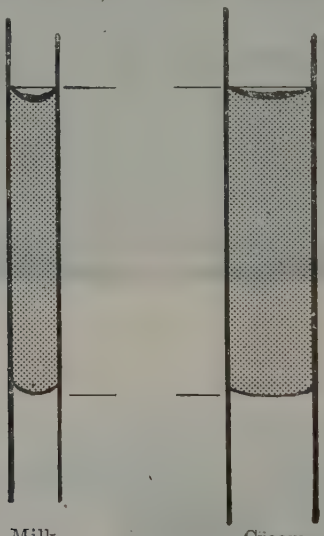


Plate 266.

How the Percentage of Fat must be Measured.—In reading the percentage of fat in both milk and cream the whole of the fat column must be measured as shown in the illustration.

THE TESTING OF SEPARATED MILK, BUTTERMILK, AND WHEY.

The Babcock test is not allowed to be used for testing of these products, as the percentage obtained is much lower than the true percentage of fat. In this connection, it may be mentioned that the average per cent. of fat in separated milk is about 0.08 per cent., and this would usually be shown by a Babcock test of 0.01 per cent., only one-eighth of the true fat percentage.

Regulation 164 provides that the method used for these products shall be the normal butyl alcohol modification of the Babcock test.

THE NORMAL BUTYL ALCOHOL MODIFICATION OF THE BABCOCK TEST.

Reagents.

(*a*) Commercial Sulphuric Acid—Specific gravity, 1·82 to 1·83 at 70 deg. Fahr.

(*b*) Normal Butyl Alcohol.

Apparatus.

(*a*) *Test bottle.*—The special double-neck bottle designed for these products. These bottles have a graduated neck of very small bore, the graduations being from 0 to 0.5 per cent., each small division representing 0.01 per cent. A second tube of much larger bore is attached directly to the bulb for filling purposes.

(*b*) *Pipette.*—The 9 ml. pipette specified in Regulation 194 and which is usually used for the acidity test. As the pipette used in the factory for acidity tests usually contains remnants of cream, it is advisable to have a 9 ml. pipette used only for this test.

The other equipment required is the same as that described for the testing of milk.

Preparation of the Sample.

Proceed as directed for milk-testing.

Determination.

Add to the test bottle in the order shown below:—

(1) 2 ml. of normal butyl alcohol.

(2) 9 ml. of separated milk, buttermilk, or whey.

(3) Sulphuric acid.

10 to 12 ml. for separated milk.
7 to 9 ml. for buttermilk.
4 to 6 ml. for whey.

Mix well after each addition

When all the casein or non fatty milk solids have dissolved, place in the centrifuge, which should have been heated to at least 130 deg. Fahr., preferably higher.

Whirl for six minutes at the normal speed.

Add hot water until the bulb of the bottle is filled.

Whirl again for two minutes.

Add hot water until the fat column is well up in the graduated neck.

Whirl again for two minutes.

Place in the hot water bath at 130 to 140 degrees Fahr. for five minutes.

Measure the entire length of the fat column by means of the dividers.

Double the reading to obtain the percentage of fat.

DEFECTS IN THE FAT COLUMN AND THEIR CAUSES.

1. Dark specks or particules of charred matter, or the whole column of fat dark in colour—

Causes:—1. Too much acid.

2. Temperature of acid and (or) milk is too high.

3. Allowing the acid to drop directly into the milk or cream, instead of down the walls of the bottle.

4. The acid and milk being allowed to stand for some time before mixing.

5. Acid too strong.

2. Particles of the white undissolved matter may appear in, above, or below the fat column.

Causes:—1. Not enough acid.

2. Temperature of acid and (or) milk is too low.

3. Acid too weak.

4. Acid and milk not shaken long enough for all curd to dissolve.

5. Curd may have been splashed into the graduated neck during shaking.

3. Foam or gas bubbles in the fat column.

Causes:—1. Using hard water containing carbonates.

2. Centrifuge not whirled fast enough.

SOURCES OF ERROR.

Particular attention should be paid to the following details, which though small in themselves have a cumulative effect and cause appreciable errors.

(1) The "tester" must be heated to not less than 130 deg. Fahr. during the whirling. If the tester is cold, the fat loses its mobility and may not rise into the neck of the bottle and lower tests result.

(2) The hot water added must have a temperature of at least 140 deg. Fahr. when introduced into the bottle. Cold water has the same effect as a cold "tester," i.e., lower tests.

(3) The "tester" must be whirled at the correct speed. A lower speed results in an incomplete accumulation of the fat and lower tests, while a higher speed causes breakages.

(4) The "tester" must be whirled for the times stated in the methods, shorter whirlings having the same effect as slower speeds, i.e., lower tests.

(5) Two additions of water must be made to wash the fat free from acid and serum. One addition of water is not sufficient to completely wash the fat and higher tests result.

(6) The sample must be at the correct temperature, when measured in the pipette. A cold sample gives a higher test and a warm sample gives a lower test.

(7) The sample must be measured in the pipette by adjusting the bottom of the meniscus to the graduation mark. This is only possible by holding the pipette vertically with the graduation mark at eye level. Remember a pipette is never intended to be used in any other manner. If the top of the meniscus is adjusted to the mark it means that less milk or cream is introduced into the bottle and lower tests result.

(8) The temperature of the fat must be between 130 deg. and 140 deg. Fahr. when the column is measured. If the temperature is higher than this the tests are high, while lower tests are obtained if the fat is allowed to cool before reading.

(9) The whole length of the fat column must be measured. Reading to the bottom of the upper meniscus is not allowed as lower tests are so obtained.

(10) Above all remember that the Babcock method is a standard method which will only give accurate results when the standard technique is followed.

STRAINING WIRES—A HANDY HINT.

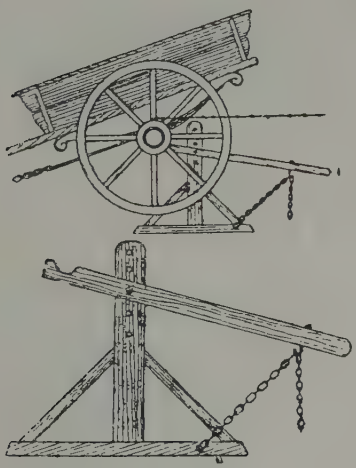


Plate 267.

The idea is a fencing hint. Sometimes when a farmer wants to strain his barbed wire, he might not have a wire-strainer handy, so my suggestion is to use a spring cart (writes a farmer in the "Western Mail"). If the horse is reasonably quiet, there is no need to take him out of the shafts. First tie a chain from the axle to the post in front to act as a brace, next jack up the wheel a few inches off the ground (will put in a sketch for a very handy light jack). Tie the wire to a spoke where it joins the hub, then turn the wheel by hand. When you have the wire tight enough push a piece of timber through the spokes then under the cart to act as brake. You can then put in a few staples to hold the wire whilst it is being tied to the strainer.

Microbes in the Dairy.

E. B. RICE, Dairy Research Laboratory (Dairy Branch), Queensland.

THE spoilage of milk and cream, because of their special value as a food, is very rapid unless every care is exercised in their production and handling and the most frequent cause of their deterioration is from the activities of the most lowly of living organisms, popularly called microbes or germs.

Application to Industry.

At the outset it is advisable to correct the erroneous impression, so frequently held, that all microbes are harmful. Because a few species are well known as the cause of certain diseases which take a heavy toll of human life, microbes have gained a reputation which is wholly undeserved. Of the numerous species those which are detrimental to animal and plant life, or are objectionable in industrial processes, are relatively few indeed, and were it not for the activities of some types several important industries might not be in existence to-day. The fermentation industries, such as brewing, winemaking and vinegar manufacture, depend upon the specific functions of certain microbes. The dairy industry itself must be regarded as one of the major fermentation industries; cheese especially could not be made without the aid of microbes. Another instance of their application to agriculture is in the making of silage, where the acid developed by bacteria prevents putrefaction. If this acid were not produced decay would result, rendering the fodder unfit for use.

Size and Growth.

Microbes can only be observed by the aid of a powerful microscope. Some idea of their extreme minuteness may be gathered from the popular illustration that 25,000 bacteria of average size when placed end to end in a row would just stretch across a halfpenny, which is exactly one inch in diameter. They consist essentially of the substance protoplasm, which is the foundation of all living matter, surrounded by a membrane called the cell wall. The jellyfish, or common sea blubber, well known to everyone, is made up almost entirely of protoplasmic material. The rapid growth of germs, coupled with the undesirable changes in milk constituents as a result of the activities of certain species, renders them of such account in dairying. This rapidity of development is bound up with their method of reproduction, which is extremely simple; the cell of a bacterium just divides into two by the process of fission and the new cells are known as daughter cells. Under suitable conditions a single bacterium is able to divide into two within a period of thirty minutes; in the succeeding thirty minutes there would be four, which would increase to eight after the next interval of thirty minutes. Such growth in geometrical progression is so rapid that in less than twenty-four hours the progeny of the original single microbe would number millions. Fortunately, under natural conditions, the by-products resulting from the activities of the germs on the nutrive substance upon which they are subsisting exert a retarding influence on their rate of growth, so that the actual numbers fall short of what they would be were ideal conditions possible.

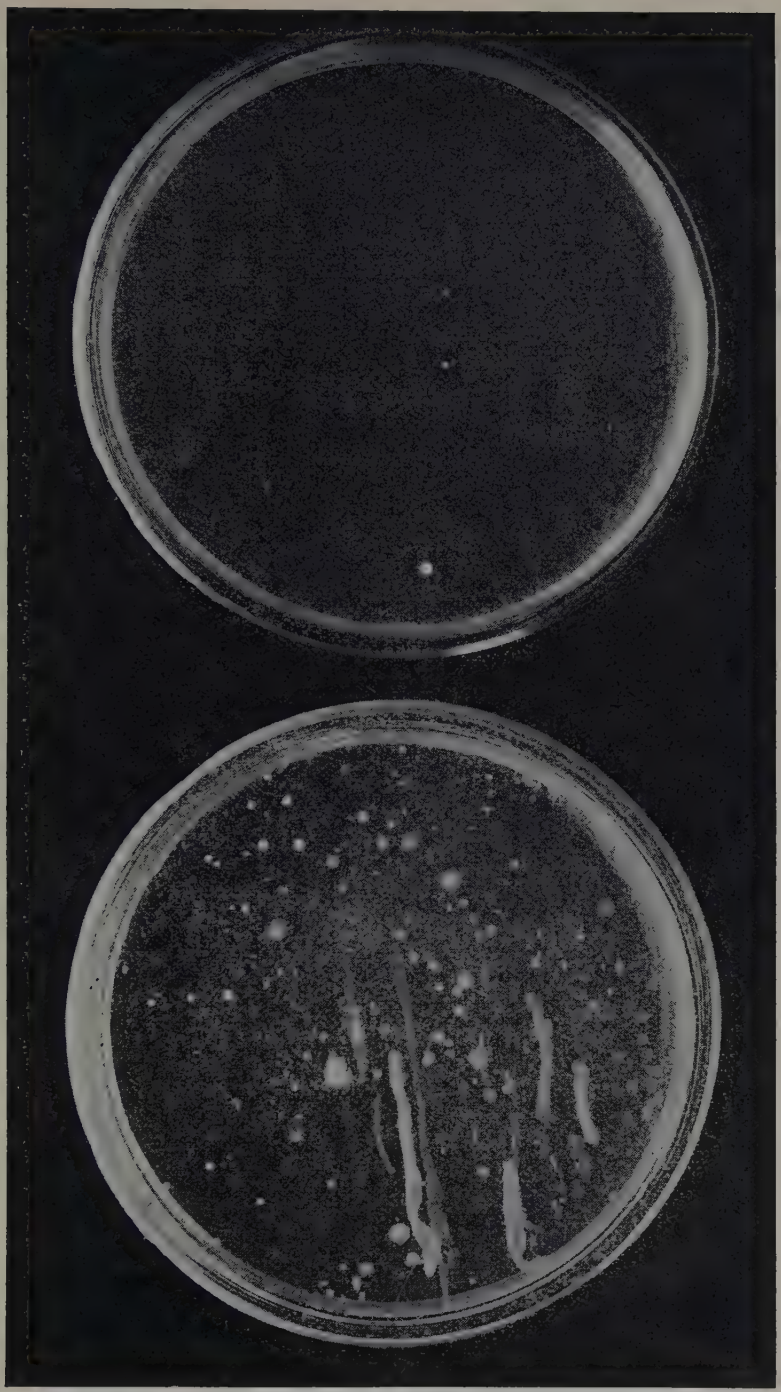


Plate 268.

PHOTO. SHOWING CONTAMINATION OF MILK.—Top: Colonies from cleanly-produced milk. Bottom: Colonies from milk produced under insanitary conditions.

Parasites and Saprophytes.

Bacteria, not having the power of independent existence, are always found in association with other forms of matter. According to whether their host is living tissue—either animal or vegetable—or inert material, they are designated as parasites or saprophytes, respectively, but there is no strict line of demarcation between these groups. Again, the parasites are divided into disease-producing (pathogenic), or non-disease producing (non-pathogenic), germs. An organism may be pathogenic for, say, animals, yet non-pathogenic for man. For instance, the causal organisms of lumpy jaw and mammitis of dairy cattle are reputed to be harmless to man.

Food.

As with all other forms of life, moisture is essential for bacterial development. Similarly, food is required, but, obviously, in exceedingly small quantity. If a teaspoonful of milky solution be left in a cream can or other utensil after cleaning, it is capable of sustaining the growth of millions of microbes which would seed any fresh milk or cream introduced into the vessel. The reason why it is always stressed to clean scrupulously and thoroughly dry afterwards any dairy utensil is thus apparent, because so long as there is a complete absence of moisture any few bacteria which remain behind after washing the vessel will be prevented from increasing in numbers.

Influence of Temperature.

The warm temperatures in the summer in Queensland prove almost ideal for the development of most microbes. Their growth is practically suspended at cold temperatures, like those of our winter nights, hence the desirability of cooling cream and keeping it cool. At temperatures of 50 deg. Fahr. or lower, growth is almost checked, although much lower temperatures are required for their destruction. Freezing water will only slowly kill most species. They are also able to adapt themselves to withstand temperatures which would be excessive for other forms of life.

The following table, abstracted from Orla Jensen's "Dairy Bacteriology," illustrates nicely the influence of temperature on rate of growth.

Milk immediately after milking .. 1,480 bacteria per ml.

Same milk, after standing eighteen hours—

At deg. Fahr.	Bacteria per ml.
48	2,100
54	5,600
59	156,000
64	550,000
70	6,750,000

Temperature also has an important bearing upon the types of microbes found in milk. If cream be maintained at 70 deg. Fahr., which corresponds roughly with spring conditions in this State, the lactic acid bacteria, which cause the familiar souring of milk, will gain almost complete control of the fermentation. These bacteria may be regarded as friends of the dairying industry, for the acid produced by

them, combined with the rapid growth at their optimum temperature, will prevent other species which bring about injurious fermentations from developing in sufficient numbers to impart any taint. At temperatures in the neighbourhood of 90 deg. Fahr., which approximates with summer conditions, many microbes which are very objectionable in dairy produce become dominant. Although it is recognised that in the summer in many of the dairying districts of this State there are difficulties in the way of cooling cream or milk to an extent sufficient to prevent any increase in the microbial flora, yet if farmers were able to cool and to keep their cream at 60 deg. Fahr. to 70 deg. Fahr. they would be going a long way towards reducing considerably the high proportion of inferior cream which is delivered to the factories at this time of the year.

Darkness and Sunlight.

Microbes prefer darkness, and strong sunlight kills them. Well-lighted and ventilated bails and dairy buildings will assist to keep them in control. To obtain the maximum benefit from the natural light, the bails should face north. Dairy farmers should bear in mind that sunlight is the cheapest germicide.

Where Microbes Exist.

The question might naturally be asked, "Where do microbes exist?" They are found in the soil, in water, in the air, and in the digestive tract of man and animals; in fact, almost everywhere. The air over high mountain peaks and the sea, some miles from the shore, is often sterile; that is, free from microbes. Their numbers are relatively few in the open air, especially in rural districts, but the air of a city street may be heavily contaminated. Dust in the stables and flies are potential sources of contamination of milk, because they always transport numbers of germs, some of which are the cause of serious defects of milk. Flies may also be the carriers of disease germs. Impure water from stagnant waterholes, dams, &c., sometimes is the means of contaminating milk. The udders, flanks, and tails of the cows wading in such places pick up germs, which, during milking, fall into the pail.

Bactericidal Action of Blood.

It may be of interest to refer to the absence of microbes in the blood-stream of a healthy person or animal. This is attributed to the ability of certain cells in the blood to digest bacteria which invade the blood-stream. Not until this natural resistance is broken down, through ill-health or other cause, are microbes able to survive and bring about disease.

Resistance to Unfavourable Environment.

A factor which renders the control of microbes a difficult problem is their resistance to unfavourable conditions, such as lack of food, unsuitable temperatures, dryness, chemical action, &c. Mention has already been made of their ability to withstand better than other forms of life unusual degrees of cold and heat. Certain microbes, usually those whose natural habitat is the soil, are able to form what is known as a spore, which may be compared with the seed of a plant. Like the seed, which is hardier than the plant itself, the microbial spore is able to withstand adverse circumstances much better than the living cell. The hardihood of a spore may be indicated by pointing out that boiling

water is unable to destroy it, unless allowed to remain in contact for some time, and spores of the anthrax bacillus which had been kept in a dried state for ten years germinated when transferred to a suitable environment. Fortunately, few of the microbes encountered in dairy products, unless they are produced and handled under conditions which can only be regarded as hygienically unsatisfactory, belong to the spore-forming group.

Control of Microbial Contamination.

Care in all stages of production and treatment on the farm and in conveyance to the factory is essential to produce milk and cream free from excessive bacterial contamination. Strict observance of the few points enumerated hereunder would go far towards checking the activities of undesirable germs, and, incidentally, deriving the monetary reward which is now provided by the Regulations under the Dairy Produce Act for cream of choice quality:—

1. Clean flanks and udders with a cloth moistened in weak condy's fluid.
2. Wash the hands before milking each animal.
3. Thoroughly clean and dry utensils after use, in the following manner:
   (*a*) Rinse in lukewarm water.
   (*b*) Immerse in boiling water.
   (*c*) Allow to drain and dry in the sun on a dust-free rack.
4. Cool cream immediately and keep it cool.
5. Exercise additional care in the summer months, when conditions are ideal for bacterial multiplication.

PULLING OUT BOGGED TRACTOR.

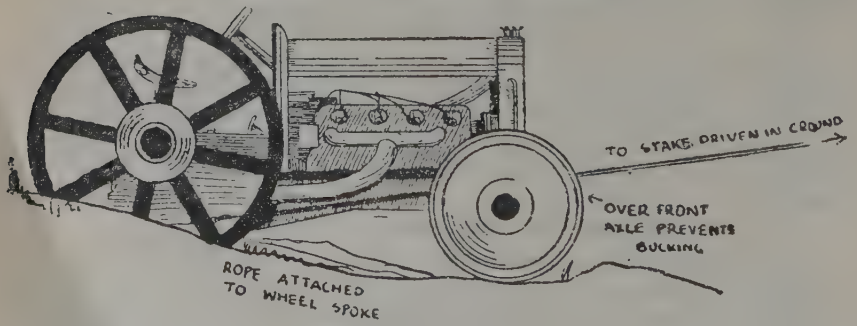


Plate 269.

The sketch illustrates a sure, safe and simple way of pulling a tractor out of a bog. Two wires or wire ropes are tied to the two rear wheels of the tractor and led forward over the front axle to an anchor of some kind in front. As the tractor is driven forward, the wheels wind the wires around themselves, and so pull the tractor forward. The wires are led over the front axle as a precaution against "bucking." This method can be used for backing also. Lorries can be pulled out of bogs in the same way.

Tobacco Culture in Southern Rhodesia.

R. A. TARRANT, Instructor in Agriculture.

The subjoined notes contain the substance of a short series of radio talks to tobacco growers, and are illustrated with snapshots taken by Mr. Tarrant in the course of a recent tour through the tobacco producing regions of South Africa.—Ed.

Soils.

THE soils on which I found most of the tobacco being grown are of granitic origin, and more or less identical with our Mareeba soils in appearance, but generally they are much richer in fertility. These soils are of varying depths of from 8 to 14 inches of surface soil, being light grey to reddish in colour. According to the geological map, Southern Rhodesia contains 49·5 per cent. of granite soil, all of which is suitable for tobacco growing, but unfortunately nearly half of the area is situated in what is considered a very uncertain and dry belt which only averages from 10 to 15 inches of rain annually, and then this rainfall is interspersed with long dry spells.



Plate 270.

LARGE TOBACCO PLANTATION, SOUTHERN RHODESIA.—This crop yielded over 700 lb. of cured leaf to the acre. Some plantations grow 250 to 500 acres and a living area is 60 acres.

In Southern Rhodesia tobacco is grown mostly on three classes of soil—viz., sandy loams, contact soils, and clay loams.

The ideal soil for flue-cured tobacco leaf (always called Virginian tobacco in South Africa), is a granite sandy loam, light grey in colour, of a depth of from 8 to 12 inches, merging into a reddish subsoil containing a percentage of clay with sand and granite mixed in suitable proportions. This allows for good drainage in a wet season and the retention of moisture in a dry or uncertain season.

The "contact" soils are mostly located on the fringe of the granitic and basement schists. Intrusions, however, may occur right in the granite belts, and any of the estates with these intrusions are considered fortunate, as the value of the land is increased. These soils are well

drained, and grow good crops of tobacco and maize, requiring less fertilizer for the production of commercial crops. These contact soils, which are classed as sandy loams, are very friable and fine in texture, and are usually very deep and reddish in colour. The contact soils recommended for tobacco growing are granite diorite, granite dolorite, granite schist, and granite banded ironstone. Besides growing Virginian leaf I have also seen fire-cured and air-cured varieties growing on these soils, but there is a very limited demand for air-cured leaf. The soils classed as clay loams, and which are entirely derived from diorite, dolorite, schist, and banded ironstone, are red in colour, and for the first year will produce leaf of a bright colour which can be flue-cured, but the leaf grows heavier and cures darker as the soil is cropped, and therefore are most unsuitable for growing Virginian leaf. Most maize crops are grown on these soils.



Plate 271.

A Farm Road.—Headlands are used in Southern Rhodesia as motor roads for transporting the leaf to the barns.

Rainfall.

Tobacco crops grow best and make uniform growth of leaf, which cures easily, when the average rainfall is between 22 to 26 inches spread evenly over the growing period.

The monthly mean rainfall for Salisbury and district spread over a period of thirty-five years:—

	Inches.
July to September	0·36
October	0·92
November	3·23
December	5·72
January	7·07
February	5·60
March	4·11
April	0·99
May to June	0·46

These statistics make an average of 28·46 inches. It will be noticed that the storms commence in October, heaviest precipitations being in



Plate 272.

BREAKWINDS.—Australian gums are grown on the headlands as a shelter break for tobacco crops in parts of Southern Rhodesia.

December, January, and February. From March to September the rainfall is very light.

These conditions compare favourably with those of Mareeba, where, however, the precipitations are slightly heavier and the general storms and seasonal rains are later. In Southern Rhodesia November and December are the usual planting-out months, the month of January being considered too late.



Plate 273.

BREAKWINDS.—Another view of gums sheltering a growing crop.



Plate 274.

A Seed Bed Layout.—All seed beds are built up, formed, and enclosed with bricks. The bricks are sterilized during the burning of the beds.

Altitude and Climatic Conditions.

It will be interesting to note that the capital of Southern Rhodesia is situated in the same latitude as Mareeba—18 deg. S.—and most of the tobacco is grown within a 70-mile radius of Salisbury.

Over 24 per cent. of Southern Rhodesia is 4,000 feet above sea level. Salisbury itself is 4,885 feet, and Sinoia, another large tobacco-growing area, is 3,793 feet. These altitudes naturally give this colony a very temperate climate.

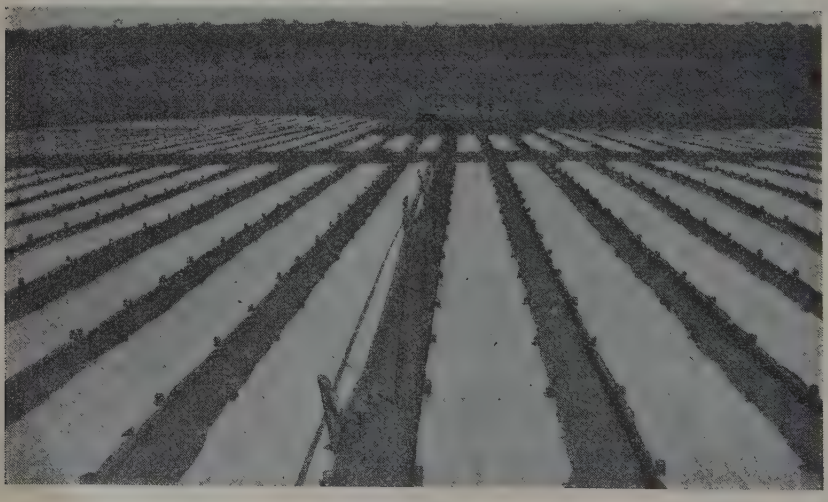


Plate 275.

Seed Beds in Southern Rhodesia.—They are covered in most instances with cheese cloths, but no storm curtains are used.

During October and November the days are hot, the mean temperature being 91 degrees, but the nights are cool, when temperatures range from 46 degrees to 54 degrees.

During December, January, February, and March the mean maximum temperatures are approximately 84 degrees, while the mean minimum temperatures 52 degrees.

The relative humidity ranges about 70 per cent. from November to March, and this is not regarded as excessive.

Salisbury is 300 miles inland, and is, therefore, uninfluenced by sea breezes.



Plate 276.

In Preparation for Transplanting.—Seedlings ready for the field being hardened off.

Rotational Cropping.

The most favoured rotation in Southern Rhodesia on the flue-cured tobacco soil is as follows:—

First year—Tobacco, with fertilizer.
Second year—Tobacco, with fertilizer.
Third year—Maize, no fertilizer.
Fourth year—Sunn hemp (*Crotaleria juncea*), ploughed under.
Fifth year—Maize, no fertilizer.
Sixth year—Tobacco, with fertilizer.

With this rotation tobacco is grown two years with fertilizer, then followed with a crop of maize, there being sufficient fertilizer residue left in the soil to produce this crop. The following year a heavy smothering crop, usually Sunn hemp, is grown and ploughed under as a green manure. This green crop ploughed under makes the soils rich in nitrogen and humus, so much so that it is not advisable to follow immediately with a crop of tobacco, so to tone the soil down the fifth year is planted with a crop of maize and then the sixth year tobacco again.



Plate 277.

CROP OF SUNN HEMP (*Crotalaria juncea*) IN FLOWER AND READY FOR PLOUGHING UNDER.—This crop is sown broadcast, rate of 40 lb. to the acre, and is used in most tobacco rotations.



Plate 278.
Showing ordinary height of a crop of Sunn hemp.

It has been found that tobacco leaf following a crop of Sunn hemp grows very coarse and thick in texture; the leaf also crinkles and is most difficult to cure.

Another rotation recommended is:—

First year—Tobacco, with fertilizer.
Second year—Velvet beans.
Third year—Cotton.
Fourth year—Maize.
Fifth year—Tobacco, with fertilizer.



Plate 279.

A Field in Southern Rhodesia.—Showing height of ridges; the crop is obviously suffering from the effects of dry weather.

This appears to be a very good rotation, but I would be inclined to substitute Sunn hemp in place of velvet beans, as the former is such an easy crop to grow and readily ploughed under if handled at the right stage of maturity, whereas velvet beans are very difficult to handle.

Preparation of Land.

The land into which the tobacco seedlings are to be transplanted should be thoroughly worked and brought into a fine tilth so that the seedlings will be given every chance to grow without receiving any setbacks.

Most of the tobacco soils in Southern Rhodesia, especially the granites, are shallow, and shallow ploughings are advocated. If the subsoil is brought to the surface it will have very detrimental effects on the yield and quality of the leaf. The clearing of the land is attended to during the wet season; the timber is never burnt, but is drawn to the headlands and cut into lengths as fuel for flue-curing purposes. The veld generally is sparsely timbered, and there is a shortage of timber throughout the populated areas. Land, by the way, can be cleared for £1 per acre in some districts, and even where the trees are denser rarely costs over £2 per acre.

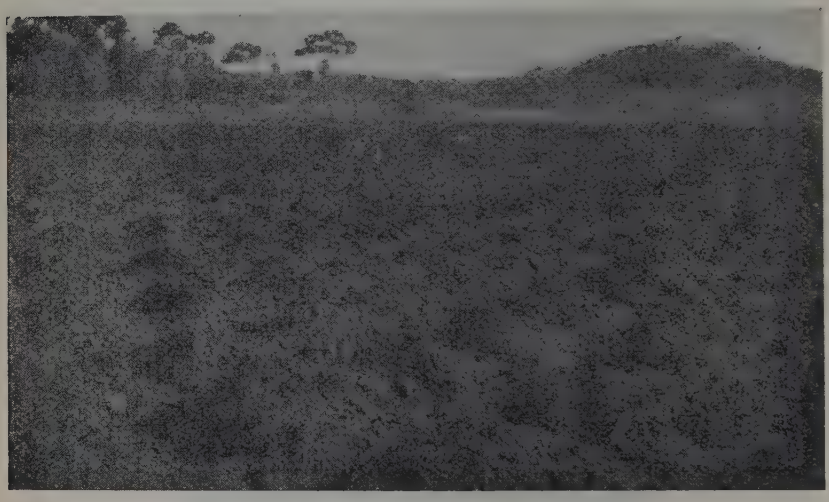


Plate 280.

A Farm Scene in Southern Rhodesia.—Showing a field "hillocked" ready for planting. The fertilizer is at the bottom of each hillock.

In Queensland we also save the timber for flue-curing fuel, but incidentally burn a tremendous amount of timber on the land. This is not recommended in Rhodesia, as the ash residues cause the growing of uneven and sometimes coarse leaf crops.

Usually the tobacco-grower ploughs his land as soon as the crop is taken off, or, with virgin land, about March or April. This early ploughing allows for the rotting of any vegetation that has been ploughed under, while there is still moisture in the soil, and also assists in sweetening the soil by letting it fallow during the winter months. The land is also worked during the winter months to keep down weed growth, and to keep the soil loose and friable and in a moistened condition.

Ploughing is done generally with a three-furrow disc plough (shave) and seven span of oxen. Horses are subject to sickness, and are never used; in fact, I did not see a horse team during my travels throughout Southern Rhodesia.

Ridging.

The light soils used for producing bright leaf are sometimes ridged, and these ridges are run east and west wherever possible to allow the plants to receive the maximum amount of sunlight. Naturally, the contour of the field is the deciding factor with regard to ridging, and is so aligned as to follow the natural drainage of the slope. They are usually made or formed 3 to 4 feet apart.

The Irrigation Department, when I was in Southern Rhodesia, was handling contour ridging and soil erosion, and officers were making visits to all farmers who were desirous of having their fields properly laid out in contour drains. Growers generally were taking advantage of this service.



Plate 281.

FIELD PRACTICE IN SOUTHERN RHODESIA.—Planting in hillocks. Some farm workers use dibbling sticks, others use their hands.

On most of the tobacco plantations visited I found that very few tobacco ridges were being put up with plough teams, the majority of the growers preferring hillocks, which were pulled up with badzas or hoes. All this work was done by hand, the hillocks being marked out with wire tapes and formed on the check system 3 feet apart. The advantages, according to the growers, in favour of the hillocking system are, firstly, the crop receives an equal dressing of fertilizer (mea-

sured cup system is practised), each hillock receiving a measured quantity; secondly, they are better able to keep the crop free from weeds; and thirdly, the crop receives an equal amount of sunlight.

Growers who oppose hillocking maintain that it exposes too much surface soil, causing loss of moisture and rapid erosion by which the roots of the plants are laid bare during heavy rain.



Plate 282.

Planting in Hillocks.—Another view.

Fertilizing.

Fertilizer is applied to the soil shortly before planting and the hillock pulled over it. Some growers, however, prefer to broadcast and harrow it in, while I have seen others hoeing out a hole in the ridge and applying the required quantity to each hole, and when transplanting placing the seedlings in these depressions.

The fertilizer used is double complete, and contains the following water-soluble components:—Phosphoric acid (P_2O_5), 20 per cent.; nitrogen (N), 7 per cent.; potash (K_2O), 10 per cent. This formula appears to be the most popular amongst growers in the poorer sandy soils, and is used at the rate of 200 to 250 lb. per acre.

On light sandy soils of greater natural fertility the following formula is suggested:—Phosphoric acid (P_2O_5), 18 per cent.; nitrogen (N), 6 per cent.; potash (K_2O), 8 per cent. It is applied at the rate of 175 to 200 lb. to the acre at a cost of approximately £2 per acre.

In this mixture the nitrogen is derived from a combination of organic and inorganic nitrogenous components.

On the dark fire-cured soil the formula recommended is phosphoric acid, 12 per cent.; nitrogen, 6 per cent.; potash, 8 per cent. This mixture is applied at the rate of 400 to 500 lb. to the acre.

Transplanting.

Tobacco seedlings are considered ready for transplanting when they are 6 inches in height, but if the seasonal rains are early they are planted out when only half this height. Growers prefer to wait for an overcast day, but if seedlings have become accustomed to plenty of sun they will withstand adverse conditions much better than plants that have been shaded. The seedlings are never covered during transplanting operations, but are left exposed to all weather conditions.

In Queensland seedlings are covered with paper tents if conditions are dry and hot, and in some instances they are watered in. In Southern Rhodesia, where the living acreage is considered to be 60 acres, it would be an impossible task to cover the young seedlings in the field. In transplanting two Kaffirs will plant 1 acre per day. These men receive in actual wages 12s. per month. This works out at approximately 6d. per day, and so it costs actually 1s. per acre to plant seedlings in Rhodesia.

The main plantings are made in November and December. This means the leaf ripens evenly, the crops reaching maturity while the weather is warm and before the rains cease. With January and February planted crops they seldom produce leaf of high quality and the yields are very disappointing. The Kaffirs sometimes use dibbling sticks when transplanting, but in most instances use their hands, especially when the soil is soft. Long tap roots are cut back close to the plant, for on no account should these roots be allowed to bend up. Plants with bent tap roots seldom make satisfactory growth.

The heart of the seedling should always be kept above the surface of the soil. If they are planted too deeply they become sanded up and die, thereby causing a very uneven strike in the field. This entails extra work in replacing plants that have failed.

According to results obtained from tobacco curing experiments in the United States of America, tobacco which reaches maturity and is harvested while the weather is still warm generally will be decidedly better in quality, particularly in respect of colour, than later harvestings.

Cultivation.

As soon as the plants have become established in the field inter-row cultivation work commences. The Kaffirs begin to work around the plants with their badzas or hoes, also along the ridges or hillocks, and the oxen teams begin to scuffle between the rows, and the plantations generally are certainly kept free from any weed growth. I

noticed that all light scufflers were being discarded and very heavy ones with three or four long tines taking their place, and these are pulled by two oxen. These tines penetrate into the soil very deeply—at least 6 inches—thereby stirring the soil up and giving it a good aeration, but at the same time no subsoil is brought to the surface during the operation. I was informed that with heavy tine cultivation better crops are grown, as with deeper cultivation the plants develop a better rooting system, and make a more even and rapid growth.



Plate 283.

In Southern Rhodesia.—Field workers dropping plants on the hillocks while others are planting.

Priming.

The removal of the lower leaves from the plants is called priming, and is done when the crop is averaging 12 inches in height. Generally, these leaves are never left on the field, but are carried to the headlands and burnt. The final priming of tobacco is made when the plants have reached the correct topping stage.

Topping and Suckering.

During the growing of the crop the Kaffirs are kept constantly in the field, especially during the topping and suckering stages.

It has been found in Southern Rhodesia that plants that have been topped too low are very prone to disease, more especially wilt, angular spot, and wildfire.

The terminal bud or flower head is taken out when the requisite number of leaves have developed and while the stem of the plant is still soft and supple. Delayed topping, or when the plants are in full flower, is not recommended, and is considered to be a waste of plant food and energy, as the stalks become hard as the flower head develops, and the operation of topping becomes more difficult.



Plate 284.
Busy Farm Workers.—Topping and suckering a tobacco crop.

All sucker growth is carried off the field and burnt as is the case with primed leaves.

Harvesting.

With large areas under tobacco it is a very simple matter to harvest leaf all at one stage of ripeness. In Southern Rhodesia 60 acres is considered a living acreage, but I saw plantations with 150 to 500 acres under tobacco, and in one instance 1,000 acres. On these bigger plantations a European section manager attends to 150 acres. His work is to supervise and keep the natives moving and attending to their allotted tasks in a proper manner, and it is not unusual to see 100 boys harvesting and working in a field. All Virginian leaf is harvested and cured by the single leaf method; the same applies to fire cured.

In harvesting the leaf is carried in the curve of the arm, but in a few instances I saw baskets in use. Each boy carries the leaf he has harvested to the headland, where big crates are placed and special



Plate 285.

PRIMING AND SUCKERING.—Kaffirs working in a tobacco crop priming and suckering in Southern Rhodesia.



Plate 286.

WAITING FOR THE WHISTLE.—Eighty odd native workers ready to commence harvesting in a tobacco crop in Southern Rhodesia.



Plate 287.

A Tobacco Transport Waggon.—Method of transporting leaf to the curing barns. In some places leaf is carried four and five miles from field to barn.

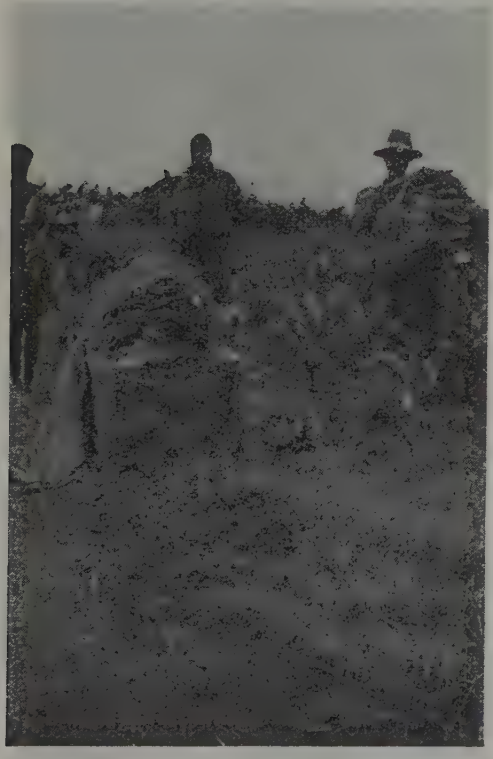


Plate 288.

Ready for the Barn.—Special "boys" pack the leaf into crates on the headlands or motor roads.



Plate 289.

This illustration shows leaf packed in crates and being transported by motor lorry to the curing barns.



Plate 290.

A plant of White Stem Orinoco Tobacco.



Plate 291.

A BRICK BARN.—In Southern Rhodesia all barns are built of brick, and the work is done by natives, even to the moulding and burning. Bricks cost 12s. 6d. per 1,000.



Plate 292.

With a battery of barns this size it is necessary to have thermometer inspection windows on the furnace side for the stoker, as well as the door or filling side for the supervisor or curer.

boys receive this leaf and pack it in the crates. The headlands are really motor roads, and are formed every 10 to 15 chains. This allows for convenience in handling the leaf from such large areas. In some instances, the leaf has to be transported miles to reach the curing barns. The crates for holding the leaf are 5 to 6 feet in length, 3 feet in height, and 2 to 3 feet in width. They are made of angle iron, braced each way, and covered with hessian. The size of the crate is made to suit the type of the motor lorries in use.

Varieties Grown.

Varietal trials over a period of years have demonstrated that the best variety suited to Rhodesian conditions for flue curing is White Stem Orinoco. All the other varieties have more or less been discarded.

The manufacturers prefer White Stem Orinoco to any other variety, as it goes through the "proctoring" or re-drying process without any damage to the leaf tissues, and this is one of the reasons why the variety is most popular. The leaf is subjected to a high temperature, which drives out all the moisture. It is cooled immediately afterwards and placed in a chamber in which it is reconditioned with a correct quantity of moisture and made fit for baling or bulking down without any fear of heating or bulk moulds.



Plate 293.

Curing barns are built usually 20 feet by 20 feet by 20 feet, and this nest of barns is capable of handling between 70 to 80 acres of leaf.

SUMMARY.

The following summary contains some very useful hints by the Southern Rhodesian Chief Tobacco Officer, and are well worth quoting:—

1. The land should be properly prepared in advance of planting operations.

2. The crop should be transplanted during the most favourable portion of the planting season.

3. Early planted tobacco generally produces the best tobacco.

4. Late planted tobacco costs as much to produce, but is of little or no value.

5. A full and even stand secures a uniform and good yielding crop.

6. The acreage is governed by barn and housing accommodation and available labour supply.

7. Correct field work reduces the difficulty in curing and handling operations.

8. Aim for quality rather than quantity.

SUPPLEMENTARY FEEDING OF STOCK.

Good foundations and framework are essential prerequisites to an elaborate building, and the same is true of a living organism. The skeleton or bony material must be well formed if it is to support the intricate mechanism of an active body. The skeleton is largely mineral matter, and of this material over 90 per cent. is composed of lime phosphate. During the intra-uterine period of its life and in the early suckling period, the young derives the whole of its mineral requirements from the mother. She in turn derives her supplies from the food she eats. When this is deficient in the required elements, nature enables her to draw upon her own reserves. Such is the overpowering force of maternity that a cow has been known to deplete her own body stores by 20 per cent. of their lime and phosphate content for the sake of the calf.

The growing animal and the producing mother require relatively large amounts of lime and phosphate to meet development on the one hand, and lactation or the needs of the unborn young, on the other. The mature male or the unproductive female require much less.

As the mineral content of good pasture closely resembles that of animals themselves there is rarely any need to feed supplementary minerals when green grass is available. When the grass dies much of the inorganic (mineral) matter returns to the soil, and is unavailable to the animal. At this time the palatability of the grasses is affected, and stock are less inclined to eat all they require for maximum production. This reduced intake means a reduced mineral intake, and may lead to a temporary mineral deficiency. On certain types of country the soil, and consequently the vegetation it supports, is deficient in some minerals, and stock grazed thereon are in a constant state of malnutrition.

Under these conditions supplementary feeding becomes an economic necessity.

This has long been understood by the producer, but there has always existed some uncertainty as to the minerals required and the amount to be fed. On farm lands where the animals are under constant observation, and where the composition and palatability of the feed is known, the question presents little difficulty. On open grazing country complications arise. Apart from the requirements of the stock the difficulty of administration must be considered. The grazier cannot afford the individual attention to animals that farm stock get. He must aim at a mineral composition which corrects the deficiencies, and at the same time automatically limits the intake to the required amount. The problem is different for each locality, and results must largely depend upon the intelligent observation of the owner. In general, a mixture of well-graded steamed bone meal and coarse salt makes an efficient and palatable lick. The salt content should not exceed one-third of the composition, and where water analyses indicate it, the salt may even be excluded. A little appetiser must then be added to the bone meal. Price will govern which is to be used. The attraction which it holds for stock will determine the amount to be added. The quantity consumed will determine how often the material is exposed. When very fibrous food is being used it may become necessary to incorporate a purgative—5 per cent. sodium sulphate (Glaubers salt) is recommended.

Steamed bone meal should be fine, uniformly graded, and of good analysis. The Department of Agriculture and Stock will report on samples submitted. Salt should be clean butcher's quality. On no account use second-hand material.

Silos and Silage.

A. E. GIBSON, Instructor in Agriculture.

IN a recent letter directed to the Department of Agriculture and Stock, on the subject of silos and silage, the correspondent mentioned that he had taken considerable interest for some time past on subjects likely to benefit the man on the land, and incidentally matters relating to silage; but mentioned that certain items which have occurred to him have either been insufficiently dealt with or totally ignored. Consequently, with a view of clearing up the several matters in connection with silos and silage on which he desires information, the following questions submitted by him are dealt with seriatim:—

Question 1.—What is the best form of silo?

Answer.—A properly roofed and watertight cylindrical structure of reinforced concrete built overground and having an internal chute for emptying purposes in preference to doors.

Question 2.—Which is the better plan? Having the height greater than the diameter or *vice versâ*?

Answer.—Silage rapidly depreciates when exposed to the atmosphere; consequently in order to reduce surface exposure to a minimum the diameters of silos are reduced as much as possible, whilst the height is increased in order to give a greater pressure to the silage for the purpose of compaction and consequent exclusion of air from the silage. Usually the proportion of height to diameter is 2 to 1 respectively, and is found to be economically preferable to those in which the height compared to the diameter is at a higher ratio, say, 2½ or 3 to 1.

Silos which are excessively high require greater strength in foundations and walls, apart from which higher power and more expensive machinery is necessary for the filling.

Question 3.—Or is there any specific proportion between diameter and height?

Answer.—This question is really answered under Answer 2, but, whilst there is no distinct or specific proportion between diameter and height, it must be clearly understood that as the diameter increases to the ratio of the height so is the density of the silage decreased unless some form of artificial pressure is used.

Question 4.—Which is the best silo? Above ground level, below ground level, or half and half?

Answer.—Although it is admitted that the filling of a pit or underground silo is extremely economical and can be effected with a minimum amount of machinery and labour, the process of emptying the silage therefrom is the most costly and strenuous of all forms of silos. The overhead silo, whilst requiring a little more power and machinery for the filling, is the most economical of all when it comes to the operation of emptying. The silo which is half above and half below ground level has all the drawbacks of the pit and overhead silo, whilst only possessed of half the benefits of the latter.

Briefly, the merits of the three silos may be summed up as follows:—

Pit Silo.—Economical in filling, expensive in emptying (it requires the services of two operatives to empty a pit silo).

Overhead.—Slightly more expensive, due to increased power and machinery in the process of filling, but is decidedly economical in the process of emptying.

Half aboveground.—Costs practically the same to fill as an ordinary overhead silo, and is as cheap to empty down to ground level. From that on the cost of emptying becomes greater with the depth below surface.

Question 5.—Give dimensions for building a 50-ton silo.

Answer.—Silo internal diameter 11 ft. 6 in.; height, 23 ft. 3 in.

Question 6.—Give quantities for making same.

Answer.—For a 50-ton silo, using a 4-2-1 mixture—*i.e.*, four parts of broken stone, two of sharp sand, and one of cement—you would require:—Cement, 70 bags; stone aggregate ($\frac{3}{4}$-in. gauge), $14\frac{2}{5}$ cubic yards; sharp sand, 8 cubic yards; reinforcement, 2 coils 36-in. K-Wire netting, 10 gauge; rendering, 1 in. inside and out, $2\frac{1}{2}$ cubic yards sand; 36 bags cement. Roof specifications depend on style adopted (gable or octagon).

Question 7.—How would you work out the necessary information from Answers 5 and 6 to enable one to build (*a*) larger silo, (*b*) a smaller silo?

Answer.—Diameter 2 $\times$ .7854 $\times$ height $\div$ 48 = tons capacity. Diameter $\times$ $3\frac{1}{7}$ $\times$ height $\times$ thickness of wall in feet $\div$ 27 = cubic yards contents of wall.

Based on the proportions of 4-2-1—*i.e.*, four of stone, two of sand, one of cement. To each cubic yard of concrete 540 lb. of cement are required ($4\frac{1}{3}$ bags). Of aggregate (stone) broken to gauge (in this instance $\frac{3}{4}$ in.) nine-tenths of one cubic yard are required and $\frac{1}{2}$ cubic yard of sharp sand.

The cement and sand together do not appreciably increase the bulk of the concrete, as they fill up the interstices in the aggregate.

Rendering (inside and out) is calculated at 2 to 1 (2 of sand and 1 of cement). This will give a sufficiently watertight job without the addition of water-proofing material.

Question 8.—What acreage of maize will fill a 50-ton silo?

Answer.—This, of course, depends on the crop; also the manner in which it was sown—*i.e.*, broadcast or drilled. Under ordinary circumstances the quantity required should be easily obtained by the cultivation of 5 acres of maize sown in drills—which method is recommended at all times in preference to sowing broadcast.

Question 9.—How is a silo filled?

Answer.—By a power-driven elevator of a similar pattern to that used on chaff or grain elevators, slats of timber being substituted for cups, or by blower—the latter being simply a fan blast-driven at a high rate of speed with delivery pipes of 6 in. and upwards led directly into the silo at the top. More power is required to a "blower" than an elevator. Whatever system is adopted for the purpose of conveying the chaffed green material from the chaff or silage cutter to the silo must make provision for its equal distribution. Where chaffed maize is indiscriminately fed into a silo, the tendency will be found for the heavier (stalk) portions to lodge in the centre, whilst the lighter (leafy) class of material accumulates around the walls.

Unless this is thoroughly incorporated with the heavier class of fodder in the subsequent fermentation which takes place, uneven settlement results. The centre, by reason of its greater solidity, does not settle to the same extent as the outside or lighter material; consequently a shrinkage from the walls occurs, admitting air, which, once fermentation has lessened, brings about a gradual decay of all the exposed surfaces of the silage.

To overcome this, all material fed into silos must be evenly incorporated and tramped tightly along the walls, and around all doors of internal chutes. To do this thoroughly necessitates the presence of a competent and reliable operative in the silo during entire filling operations. Note that all doors that come in contact with the silage must be rendered airtight. This can be effected by covering them with tarred brown paper.

Although the question was not asked by the correspondent, it is thought that a few points on emptying will not be amiss.

When emptying use a strong-toothed rake, and rake evenly from the top the amount of silage required for the daily ration. At all times avoid digging into the bulk of the silage. Remember that the more even and level the surface of the silage is left after each daily ration is obtained, the less decomposition and consequent waste will occur. If your silo has doors fitted to it, keep them closed; there is then less strain on the hinges and the doors (which are weighty) would fit more snugly when refilling, apart from which there will be no chance of rain destroying the silage, for nothing tends to bring about the decomposition of silage quicker than the admission of either air or water.

THE BLENDING OF CREAM.

The great importance of the operation of blending cream is evidently not well understood by many farmers, judging by the condition in which much cream reaches the butter factories. Lack of proper attention to this vital matter is often the cause of undesirable fermentations, which detract from the bright, aromatic flavour desired in choice cream, and results in the consignment being graded down.

The practice of holding the cream from each separation in a separate utensil encourages the development of faults like staleness and overripeness in the portions which are kept longest on the farm, and the mixing of these portions with the other separations just before despatching to the factory gives a bulk cream of inferior flavour. Adding the cream straight from the separator, without in any way reducing the animal heat, to a partly-filled can of cream from a previous separation is another practice which merits the severest condemnation.

The correct procedure to follow is to mix each batch with the bulk after the heat has been reduced, which usually takes about an hour, unless cooling devices are used, when the different portions can be mixed immediately. It is much easier to prevent off flavours from developing by keeping the cream in larger quantities than by retaining each separation in a separate container.

Some farmers consider that by keeping each separation apart the risk of getting second-grade cream is minimised, or, at any rate, that only part of the supply is likely to be graded low. However, modern methods have demonstrated very definitely that correct blending of cream, by ensuring an even souring, helps to achieve choice quality.

Stirring of the cream at regular intervals throughout the day may be regarded as an essential point in the correct blending of cream. It assists to obtain even ripening and even consistency. Finally, it should always be the rule to deliver to the factory as frequently as transport arrangements will permit, for the longer that cream is kept on the farm the more difficult control of ripening becomes.



THE prolonged dry weather is now causing serious concern to farmers and dairymen throughout the South Coast and Downs areas. Scattered storms occurred early in October, but few districts received over an inch, while subsequent storms produced only light falls. Pastures are now very dry. The diminishing water supply has also become a problem with many farmers. It is noteworthy that in spite of the conditions briefly outlined, the demand for good farm land persists.

Wheat.

Harvesting commenced during October under favourable conditions, ripening being hastened by the dry spring. Reports indicate that a large area has been utilised for grazing purposes owing to the shortage of natural feed, a factor that will considerably reduce the prospective yield. Some excellent crops have been harvested in the Evanslea, Bongeen, Oakey, and Pittsworth districts, illustrating the possibilities of modern cultural methods, even during unfavourable seasons. However, the average yield will be below the normal figure for the State, and many farmers will need to purchase their seed supplies for 1937 sowings.

The rise in wheat prices is an encouraging feature, recent sales having been effected by the State Wheat Board on a basis of 5s. 6d. per bushel f.o.r.

Peanuts.

At a recent meeting held at Wooroolin, Mr. C. F. Adermann, chairman of the Peanut Pool Board, stated that a surplus of Red Spanish peanuts from the 1935-36 crop was held at the silos, owing to the unusually heavy deliveries amounting to approximately 4,100 tons. Further plantings of this variety are therefore not desired at present, growers being advised to give preference to the Virginia Bunch. The Board received a total of 7,000 tons during the 1935-36 season, which, with outside railings, would indicate a total crop of approximately 9,000 tons. For the coming season it is estimated that 4,500 tons of Virginia Bunch will be required, which, at an average of ½ ton per acre, will necessitate over 9,000 acres being planted to ensure a safe crop.

Cotton.

The harvesting of the 1935-36 cotton has finally been completed with a total production of 19,187,634 lb. of seed cotton, or 13,504 bales

of lint. The total, while lower than the 14,515 bales of last year, is very satisfactory, considering the adverse conditions the crops encountered, and is considerably greater than was anticipated at one period. Had the severe and unusual jassid attack not been experienced in the Callide Valley the total would undoubtedly have been considerably greater. Many crops gave promise of good crops at mid-season, but were so badly attacked by this pest during the extraordinary period of cloudy weather in March, that only a first picking was obtained.

Seed distribution for the coming crop still continues, the total to the 22nd October being sufficient to plant at least 52,000 acres, as compared to 58,300 acres at this time last season. The continued outstandingly dry conditions have undoubtedly influenced some growers to withhold their orders for planting seed, but following on the receipt of good rains it is anticipated an acreage equivalent to that of the previous season will be planted, as many farmers who have already ordered seed either have not grown cotton previously or have not grown it for many years.

Several light general storms have been experienced during the month, but in only a few fortunate localities has sufficient rain occurred to enable a strike to be obtained. Some dry plantings have been lost through just enough rain falling to start germination and spoil the seed. Ample time still exists, however, to obtain highly profitable yields, based on the results realised in previous seasons; so it is to be hoped that good soaking rains are experienced in the near future.

Sugar.

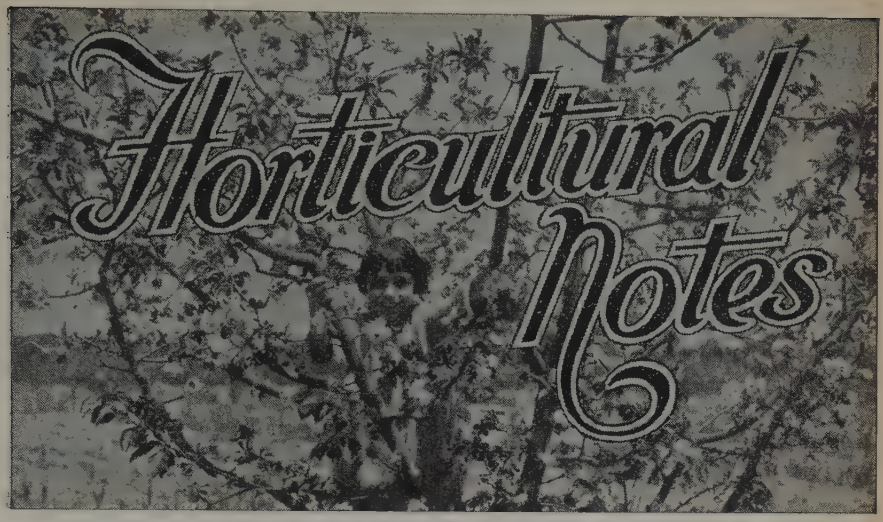
All mills report excellent progress in dealing with the 1936 crop, which is of record proportions in many cane areas. The crop is now at its peak of sugar content, which is rather abnormal. This is to be expected with heavy tonnage yields.

The prospects for 1937 are very good in the areas north of Townsville, though storm rains would be welcomed. In the areas south of Townsville acute drought conditions prevail; this is particularly the case in the southern areas, where the prolonged dry spell will definitely be reflected in the 1937 harvest. Any substantial prolongation of drought conditions will be serious.

General.

Local reserves of stored grain and fodder have become depleted, resulting in steadily increasing prices and increased importations from New South Wales. Some recent prices realised are as follows:—Lucerne hay, £10 per ton; oaten chaff, £6 10s.; Wheaten chaff, £6 5s.; mixed chaff, £8 1s.; pumpkins, £9 10s.; potatoes, £14; onions, £21 10s.; maize, 4s. 7d. per bushel.

The present seasonal conditions indicate the necessity for increased attention being devoted to fodder conservation on every farm every year, both for normal winter and spring feeding, and as provision for the inevitable dry spells. As good rains may be anticipated during November and December, successive plantings of crops, such as maize, sorghum, millet, and cowpea, can be made for green feed and silage purposes. Coastal climatic conditions do not always favour the making of good quality hay, but silage and maize grain should be held in reserve on every farm where suitable soils exist. Such action is preferable to purchasing supplies at the high prices indicated.



HARVESTING AND PACKING OF PEACHES AND NECTARINES.

IN comparison with other fruits, the marketing of stone fruits presents greater problems to growers in the placing on the market of a first grade article, and growers will obtain satisfactory results only by the exercise of great care. It must be remembered that, in order to ensure quick sales and prompt clearances from the market, it is necessary to present the fruit in its most attractive manner. Peaches left stored in the markets for even short periods stand a great risk of becoming affected with diseases such as Brown Rot. It is therefore necessary that fruit be allowed to ripen as much as possible before being harvested.

Maturity.

It must be remembered that stone fruits are different in their manner of ripening from other fruits. Whereas apples and pears can be harvested before they reach the fully ripe stage and yet attain perfection of quality and flavour, this is not the case with stone fruits such as peaches, apricots, and plums. In order to attain perfection these should be allowed to ripen on the trees. This, of course, would raise unsurmountable difficulties in the marketing of these fruits, so it is necessary to remove the fruit from the trees prior to the ripening stage. In this respect experience is the best teacher, and growers soon learn to ascertain the correct stage of maturity at which to pick the fruit. The fruit should be fully matured before harvesting, as is shown by a change in the coloured portions of the peach from dull to rich tints. If intended to be transported for long distances, fruit at this stage of development is ready to be removed from the tree. When it has to be transported for only short distances, however, it is advisable to allow the fruit to develop to a further stage until a tendency to softening at the point and bottom end of the lips is noticed. Peaches removed from the trees in this latter condition ripen almost perfectly. Fruit picked too green is always unsatisfactory, being unattractive in colour, deficient in flavour, and usually shrivelled in appearance when so-called ripe; as dessert fruit it is of poor quality, being only suitable for stewing.

Transit Troubles.

One of the greatest difficulties in the way of successful marketing is the fungus disease of Brown Rot (*Sclerotinia cinerea*). This disease attacks the fruit, generally during the ripening stage, both on the tree and during transport to the market. As any injury or break in the skin of the fruit will facilitate the attack of the disease, it can readily be seen that care in handling is very necessary.

Ordinary transit rots, of course, also play their part in causing loss in transit over long distances.

To assist in overcoming these troubles, in addition to adopting the usual methods of control in the plantations and packing-sheds, growers should use only new cases. Second-hand cases are often infected with the spores of these diseases, which will readily infect the fruit during transit to market.

Containers.

The most satisfactory case to use is the Dump Half-Bushel, 18 inches long by $7\frac{1}{8}$ inches wide by $8\frac{2}{3}$ inches deep. When properly packed, this case will carry the fruit in satisfactory condition over quite long distances.

A very satisfactory method of marketing peaches would be with the use of cartons. The cartons could be made with veneer wood or cardboard, and would contain a single layer of fruit. If made 9 inches long by 7 inches wide by $2\frac{3}{4}$ inches deep, an ordinary half-bushel box would hold six cartons. This method of marketing peaches has been tried with success in many parts of the world. It must be remembered, of course, that this type of package should be used only for high-class types of fruit.

Harvesting.

As previously mentioned, the fruit should be allowed to develop to a satisfactory degree of maturity before being removed from the trees. Baskets or specially made picking containers should be used for receiving the fruit from the trees. A satisfactory picking bucket can be made from a kerosene tin cut lengthways and fitted with a handle or with a strap to hang over the shoulder. The fruit should be carefully placed in the picking container, and the same care taken when transferring it to the orchard boxes. The boxes should be placed on the shady side of the trees in order to protect the fruit from heat and sun. The orchard boxes should be transported to the packing shed as soon as possible after being filled, and there stacked in a cool place with spaces left for cool air to flow between the boxes. When the fruit is cool, packing can be commenced. If these precautions, however, are not taken and the fruit is packed whilst it is still warm, it will sweat and tend to generate its own heat, which will cause premature ripening and a high humidity favourable to the growth of fungus diseases, thus greatly lessening the life and transportable distance of the fruit. This necessity for adequately cooling the fruit, before packing and during all handling and transporting, cannot be stressed too strongly.

Packing Shed.

The equipment of an up-to-date packing shed for handling peaches is not costly, most of the accessories for a well-equipped shed being easily made. These should consist of:—

Case-making bench (Plate 297);

Packing bench (Plate 294);

Packing stand and spring board (Plate 295);
Nailing-down rack (Plate 299);
Sizing gauge made of 3-ply (Plate 300);
Nail boxes;
Stencils and inking pad.

All of these necessities can be made by the handy man during wet or quiet periods. The total cost would not exceed £4 for materials.

The case-making bench should be solidly made with slots to hold the case ends in position while the side boards are being nailed on to them. The legs should be placed beneath the slots in order to make the structure as solid as possible when driving nails. The slots should be at least an inch deep and long enough to hold the case ends, and should be placed eighteen inches apart.

The packing bench should be 5 feet long by 3 feet wide, and tilted to have a height of 30 inches in front and from 34 to 36 inches at the back. Where a mechanical sizer is used, there would be no need for this bench to be built.

The packing stand is built to hold three half-bushel cases, measuring 21 inches in width and 18 inches from front to back, and is tilted so that it is 24 inches high in front and 28 inches at the back. A stand of this size will enable three different sizes of fruit to be packed at the same time.

A spring board for packers to stand upon whilst packing consists of three pieces of 6-inch flooring timber 2 feet long, joined across the ends by two pieces of 2 inches by 2 inches. The board rests upon the pieces of 2 inches by 2 inches, thus giving the packer a springy surface to stand upon whilst working, and assisting greatly in saving the operator's feet and back from getting tired.

The nailing-down rack is made of two pieces of 3 inches by 2 inches placed 16 inches apart and mounted on legs. The packed cases are placed across the rack so that the lengths of 3 inches by 2 inches rest underneath the ends. This will enable the bottom of the case to bulge slightly when the lid is applied to the packed case, thus assisting to keep the pack tight.

A piece of 3-ply 20 inches long by 6 inches wide in which are cut five circular holes 2 inches, $2\frac{1}{4}$ inches, $2\frac{1}{2}$ inches, $2\frac{3}{4}$ inches, and 3 inches in diameter, respectively, is an extremely useful accessory. The names of the packs for the respective sizes can be written alongside the holes.

Stencils can easily be cut from thin sheet zinc by using a heavy pocket knife or a hammer and chisel. It is useful to always keep a sheet of light-gauge zinc in the shed from which stencils may be cut at a moment's notice when required. No up-to-date grower need use pencil or crayon.

When laying out the shed, the equipment should be so placed that the work is permitted to run smoothly from one end of the shed to the other; that is to say, the fruit is received at the door at one end, then packed and the cases nailed up, and the completed cases despatched from the other end of the shed. A little thought given to the organisation of the shed in this way will save much time and labour. After all, harvesting and packing during the height of the season is usually more than a full-time job, so it is certainly worth while to reduce time and labour wherever possible.

Packing Material.

The use of sheets of corrugated cardboard for lining the cases is recommended, so that the packed fruit is protected on the top, sides, and bottom. The corrugated side of the cardboard should be placed to the wood of the box so that the fruit will rest against the smooth side; otherwise the fruit will become marked. The amount of cardboard required for each case is:—

2 sheets 18 inches long by 7 inches wide; and
2 sheets 18 inches long by 8 inches wide.

The cost per case would be approximately one penny. Where this method of lining is used, there will be no need to line the case with lining paper. However, if the cardboard is not used, the cases should be lined with a plain, white, or coloured paper. A layer of wood-wool on the top and bottom of the case is an added protection; the wood-wool is placed outside the lining paper. The procedure is, when packing, to place a layer of wood-wool on the bottom of the case and the lining paper placed on the wood-wool; the fruit is then packed, the lining paper folded over, and a layer of wood-wool placed on top of the paper before placing the lid in position. Care should be taken that the wood-wool does not come into contact with the fruit, as if it does, it will cause pressure marks. Pieces of lining paper 18 inches by 20 inches in size should be used, two pieces to each case.

Grading.

Grading the fruit for quality is always worth while. Modern marketing conditions show an outlet with the retail trade for two qualities. The high-class shops do not desire to buy a mixture of quality, as they have no demand for a second-quality article, and to foster this trade, which always commands the top prices, it is advisable to definitely keep the high-class fruit separate. This can be easily achieved by placing all poorly-coloured, blemished, and badly-shaped fruit on one side to be packed separately as a second-grade. The first-quality would be branded "Extra Fancy," and the second-quality "Fancy." These terms are now in general use in the fruit trade as trade designations.

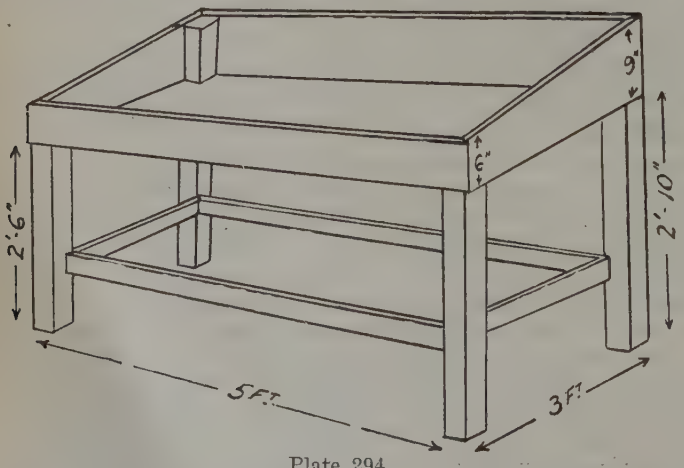


Plate 294.

Fruit Bench to Hold Fruit Whilst Packing.—Where there is no mechanical sizer this type of bench is very useful. Greatest efficiency is obtained when only one case at a time is tipped for packing. Please note that the bench is higher at the back than at the front, allowing the fruit to always be close at the packer's hand.

Wrapping.

It is always advisable to wrap peaches for long distance transit to market. The wrapping of peaches isolates each individual fruit from the possibility of disease infection from its neighbour, so that in the event of one fruit becoming affected the wrapping paper is a means of preventing infection to the fruit next to it. Wrapping also assists in making a better pack, as there is not the tendency for the layer of fruit to buckle and slip about as when fruit is packed unwrapped. When wrapping, the fruit should be placed in the wrapping paper and the ends of the paper folded under and on to the cheek of the fruit, forming a pad on which the fruit is placed, giving a very finished and neat appearance to the wrapped and packed layer. The dull side of the paper is always placed to the fruit, each fruit when wrapped having the shiny side of the paper to the outside.

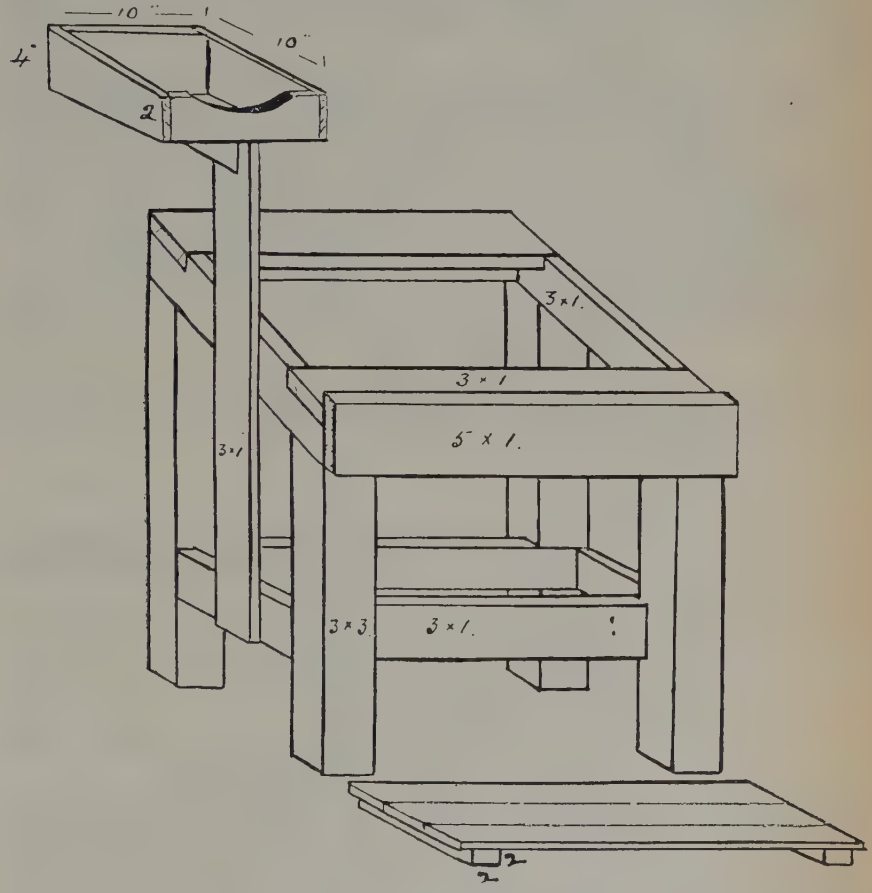


Plate 295.

Packing Stand with Paper Holder and Spring Board.—This stand is tilted and holds three cases. The tilt assists the packer by keeping the peaches in position. The packer by packing three cases of different sizes at the same time is assisting himself in his sizing. Where it is not intended to wrap the peaches the paper holder can be dispensed with.

Sizing.

Sizing the fruit before packing assists greatly in making packs easy to do and easy to bring to the correct height in the case, although there

are packers who find no difficulty in packing unsized fruit by using a roomy bench (see Plate 294) to hold the fruit, tipping one case only on the bench at a time. The packer then packs two different sizes at the same time, and, while packing, sorts the remaining sizes into separate heaps on the bench. Growers who are fortunate enough to have a mechanical sizer will find the operation of packing made easier, provided care is taken to avoid the pitfalls associated with mechanical sizers. Firstly, it should be remembered that in practically all mechanical sizing machines two different counts of fruit can be packed from each bin. Packing is made very easy if this rule is observed. To enable this to be done, it is well to have packing stands of the type illustrated (Plate 295). Another point well worth remembering with the roller and belt type of sizing machine is to have the correct gear ratio between the carrying belt and the sizing roller. The gear wheels necessary for this to be done should be supplied by the manufacturer with the machine. Fruit should be handled with extreme care when using mechanical sizers.

Fruit is always sized according to the measurement of its diameter, from side to side, and not from stalk to bottom. The following sizes are used:—2 inches, 2¼ inches, 2½ inches, 2¾ inches, and 3 inches. The size is determined by having a set of rings made with these diameters, the peach being placed on the ring with the stalk up. Any peach that will fall through a 2¼-inch ring is classified as a 2-inch peach. Likewise, a peach that will go through a 2½-inch ring and not through a 2¼-inch is classed as a 2¼-inch peach. This method is repeated to determine all sizes. A handy gauge can be cut from a piece of three-ply with a washer-cutter or carpenter's expansion bit.

Packing.

The standard diagonal cheek system of packing is best. This pack has the following advantages:—

A given size of fruit will always come to the correct height in the case.

The packed fruit will always appear in straight lines diagonally, across and up and down the case, whether opened on the top, bottom, or sides.

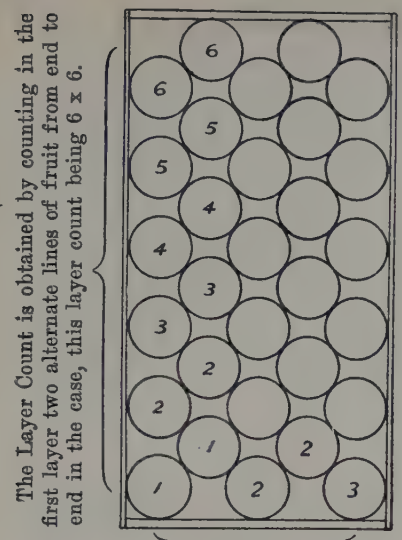
No two peaches will rest upon the other, but in the pockets formed between the fruit of the layer beneath.

The height of the fruit in the case can be governed by making the pockets larger or smaller.

The quantity or number of fruit in the case is always the same for each pack, and can be ascertained at a glance.

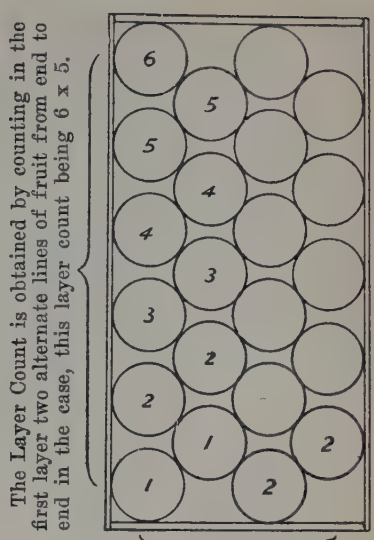
By using the packing stand illustrated (Plate 295), the cases are slightly tilted, which helps to keep the fruit in position, making the packing much easier. The packer stands with the two cases to be packed into in front of him, with the fruit on one side of the cases and wrapping paper on the other. The bench with the fruit on should be made tilted to permit the fruit to run to within easy reach of the packer. Right-handed people should always use their right hands for selecting fruit for packing.

The packs used are called the 3–2, the 2–2, and 2–1 (see Plate 296). These packs get their name from the way the first two lines of fruit are placed in the first layer.



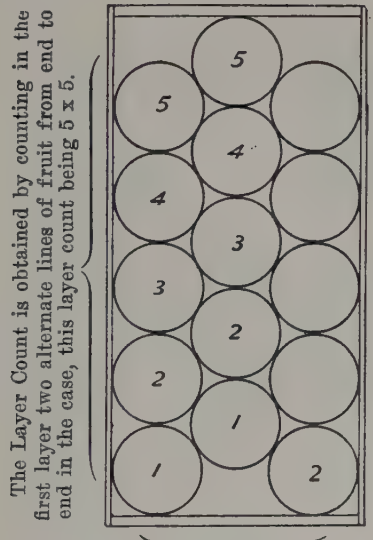
3-2 PACK.

The Pack gets its name from the way the first five fruit are placed in the layer. The Count is made of the first two lines of fruit across the case.



2-2 PACK.

The Pack gets its name from the way the first four fruit are placed in the layer. The Count is made of the first two lines of fruit across the case.



2-1 PACK.

The Pack gets its name from the way the first three fruit are placed in the layer. The Count is made of the first two lines of fruit across the case.

Plate 296.

How to read and use the packing table. Explanation of the name of the packs.

3 x 2 Pack.

This pack is used mostly for packing nectarines.

In the 3 - 2 pack the first layer is started by placing a nectarine with the lips up in each corner of the case and one exactly midway between them facing end to end in the case, the stalks facing the packer, and the nipples facing to the other end of the case. This forms a line of three nectarines with two spaces, or pockets, between them. The pack is continued by placing two nectarines in these spaces, which leaves three pockets between the two nectarines. We repeat the placing of three nectarines in the pockets and then alternately two and three until the layer is finished, except for the last line of fruit; this is reversed with the stalks facing the wood of the case end furthest from the packer. To start the second layer (see Plate 309), place two nectarines in the pockets formed by the first three nectarines of the first layer, then two and three alternately facing as in the first layer, until all the pockets of the first layer are filled, again reversing the last line of fruit across the case. This process is repeated layer by layer until the case is filled. With the 3–2 pack we get packs containing six layers (see Plate 309). (See packing table, page 684). An easy way for the beginner to be able to know the number of layers in a case is to remember that in the case of the 3 - 2 pack the first, third, and fifth layers will start with three at the end nearest the packer, and the second, fourth, and sixth layers start with two at the end of the layer. The reason for the need of knowing this is explained in the paragraph on bringing the pack to the correct height in the case. Very few varieties of peaches are small enough to be packed with the 3 - 2 pack, but many nectarines have to be packed 3 - 2.

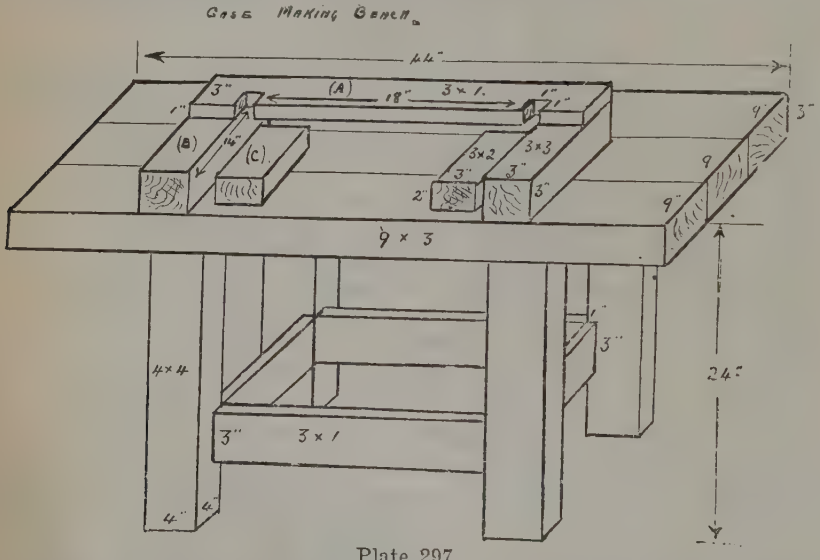


Plate 297.

CASEMAKING BENCH.—For making Australian Dump, Canadian Standard, Bushel and Half-Bushel Cases, and other Fruit Cases, 18 inches in length, inside dimensions.

Specifications.

Length	..	44 inches	
Height	..	24 inches from floor	
Width	..	27 inches	
Timber.—Legs	..	..	4" x 4"
Stops—Outside			3" x 3" (B)
Inside	..		3" x 2" (C)
Back	..		3" x 1" (A)
Top	..	..	9" x 3"
Stays	..	..	3" x 1"

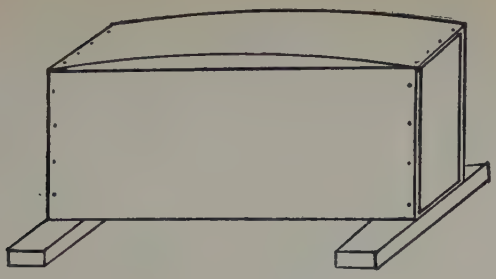


Plate 298.

NAILING-DOWN ON BATTENS.—Where a grower does not have a nailing-down bench, two pieces of 3 x 2 placed under the ends whilst nailing make a good substitute.

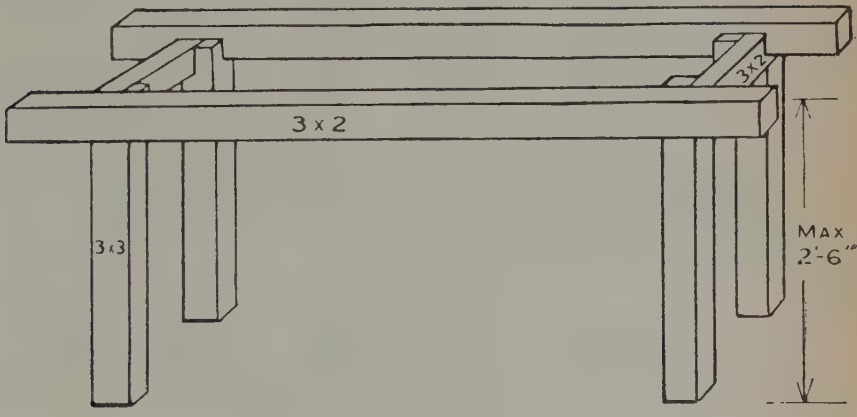


Plate 299.

NAILING-DOWN BENCH.—This enables the bottom of the case to bulge slightly with the pressure of the fruit. This keeps the pack tight in transit preventing the fruit from rubbing or becoming damaged.

2 x 2 Pack.

This pack is started by placing a peach with the lips up in the bottom left-hand corner of the case, and midway between the peach and the right side of the box a second peach, leaving two pockets between the two, in which the next two peaches are placed, forming the two-two from which the pack derives its name (Plates 296 and 301.) This is then repeated, the peaches being placed facing the same way until the layer is finished with all but the last line of fruit. This is reversed, with the stalks facing the wood of the case end furthest from the packer. The second layer is started by placing two peaches with the lips down on the pockets formed by the first two of the first layer (see Plate 307), the layer being finally finished by placing peaches on all the pockets of the first layer and reversing the last line of fruit as in the first layer. By repeating this layer by layer the case is finished. It will be noticed by referring to the table that the 2-2 packs contain five layers. If close attention to the rule of starting the first layer in the left-hand corner is observed, the number of layers in the case can be easily counted, the first, third, and fifth layers starting in the left-hand corner, and the second and fourth starting in the right-hand corner.

Packs to use when packing peaches in the Dump Half-bushel case, 18 inches long by $7\frac{1}{8}$ inches wide by $8\frac{2}{3}$ inches deep (inside dimensions) :—

TABLE I.

Approximate Size.	Pack.	Layer Count.	Number of Layers.	Total.
Inches.				
2	2–2	7 x 7	6	168
2	2–2	7 x 6	6	156
2	2–2	6 x 6	6	144
2	2–2	7 x 7	5	140
$2\frac{1}{8}$	2–2	7 x 6	5	130
$2\frac{1}{8}$	2–2	6 x 6	5	120
$2\frac{1}{4}$	2–2	6 x 5	5	110
$2\frac{1}{4}$	2–2	5 x 5	5	100
$2\frac{1}{2}$	2–2	5 x 4	5	90
$2\frac{1}{2}$	2–1	7 x 7	4	84
$2\frac{3}{4}$	2–1	7 x 6	4	78
$2\frac{3}{4}$	2–1	6 x 6	4	72
$2\frac{3}{4}$	2–1	6 x 5	4	66
3	2–1	5 x 5	4	60
3	2–1	5 x 4	4	54
$3\frac{1}{2}$	2–1	4 x 4	4	48
$3\frac{1}{4}$	2–1	4 x 3	4	42

PACKS TO USE WHEN PACKING NECTARINES.

In the Dump Half-bushel case, 18 inches long by $7\frac{1}{8}$ inches wide by $8\frac{2}{3}$ inches deep (inside dimensions) :—

TABLE II.

Approximate Size.	Pack.	Layer Count.	Number of Layers.	Total.
Inches.				
$1\frac{3}{4}$	3–2	8 x 8	6	240
$1\frac{3}{4}$	3–2	8 x 7	6	225
$1\frac{3}{4}$	3–2	7 x 7	6	210
$1\frac{3}{4}$	3–2	7 x 6	6	195
2	3–2	6 x 6	6	180
2	3–2	6 x 5	6	165
2	2–2	7 x 7	6	168
2	2–2	7 x 6	6	156
2	2–2	6 x 6	6	144

Larger nectarines can be packed by using the counts as for peaches.

PACKING PEACHES IN TRAYS FOR EXPORT.

Inside dimensions of tray—18 inches long by $14\frac{1}{4}$ inches wide by 3 inches deep.

TABLE III.

Approximate Size.	Pack.	Layer Count.	Number of Layers.	Total.
Inches.				
$2\frac{1}{2}$	5–4	4 x 4	1	36
$2\frac{1}{2}$	5–4	4 x 3	1	32
$2\frac{3}{4}$	4–4	4 x 3	1	28
$2\frac{3}{4}$	4–4	3 x 3	1	24
*3	4–3	3 x 3	1	21
*3	3–3	3 x 3	1	18

* These sizes are packed on the flat side of the fruit so that no pressure will take place when the trays are placed together.

2-1 Pack.

This pack is started by placing two peaches, lips up, one in each corner of the case. This leaves a pocket in which the next peach is placed, forming the 2–1 from which the pack gets its name. The layer is then finished by placing the fruit in lines of two and one until filled. The second layer is started by placing one peach in the first pocket of the first layer (Plate 307) with the lips down. The second layer is finished by placing two and one alternately in the pockets of the first layer until it is finished. The same system of placing in the pockets of the previous layer is adopted for the other layers until the case is filled. 2–1 packs have four layers to the completed case.

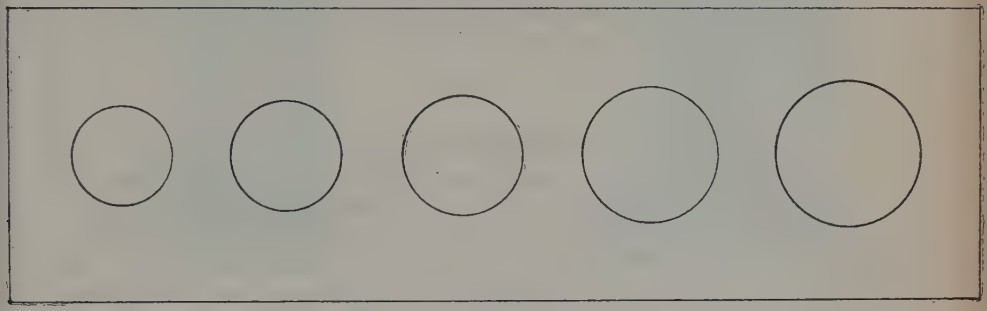


Plate 300.

GAUGE FOR MEASURING FRUIT.—Holes are cut in a piece of three-ply 2, 2¼, 2½, 2¾, and 3 inches in diameter.

Bringing the Pack to the Correct Height in the Case.

Peaches should be packed ½ inch to 1 inch above the top of the case, and be gently eased into position before applying the lid. After nailing, both the lid and bottom of the case should show a slight bulge. Care should be taken that the bottom of the case, while nailing, is kept clear of the floor or nailing-down stand. This, if a nailing-down rack is not used, can be done by placing a block under one end of the case while easing the fruit into position and nailing.

Knowing the number of layers in a case at any stage of packing is a good guide to a packer. By calculating the height the fruit will come to in the case two or three layers before the top is reached, the packer, by applying the rule, "The size of the pockets governs the height of the fruit in the case," can bring the fruit either higher or lower, as necessary. This is done by making the pockets smaller by slightly increasing the size of the fruit, and bringing the fruit higher in the box to correct a pack which will come too low, or, in the case of a pack that is coming high, to open the pockets by reducing slightly the size of the fruit. Usually these faults are caused by a variation in sizing the fruit in the subsequent layers after placing the first layer in position. Cases not of the correct width are often the cause of trouble in bringing fruit to the correct height, but by following the rule governing the size of the pockets this difficulty may be overcome. It should be remembered that it is an offence against the Fruit and Vegetables Act to market fruit in undersized cases.

Packers observing the following rules should have no difficulty in obtaining good results with their packing:—

1. All fruit should be placed with the lips in the pockets and facing end to end in the case.
2. In the first layer the lips are placed facing up, whilst in the second and subsequent layers the lips face downwards.
3. Reverse the last last two or three peaches, as the case may be, in each layer.
4. See that all fruit appears in straight lines from end to end in the case, across and diagonally.
5. No two peaches must rest directly one upon the other, but in the pockets of the layer beneath.
6. The size of the pockets governs the height of the fruit in the case.

Case Get-up.

After taking care in packing, growers should be careful to attend to the outside appearance of the case. A well-chosen label is an attraction to buyers, being quite a cheap advertising medium, the average coloured label costing very little. Growers not marketing fruit in sufficient quantity to warrant an outlay on labels may still make their cases look attractive by neat stencilling. Under the Fruit and Vegetables Act it is necessary for the packer to brand his initials, name, and address legibly and durably within a space measuring not less than 5 inches long by 2 inches wide. The name of the variety of fruit and the size or count should also be branded in letters of not less than ½ inch in length. Pencil or crayon markings on the ends of cases are unsightly, and not to be recommended.

Wiring.

A machine for this purpose is obtainable commercially. Wiring is recommended in all cases. Many country-order buyers pay extra to obtain cases wired, as it saves them time and money when they can procure the cases ready wired for long-distance transport. Two wires should be used being placed around the ends of the case just inside the inside edge. A single wire around the middle of the case is not recommended, as when it is tightened around the bulge of the top and bottom it will cause damage to the fruit through pressure.

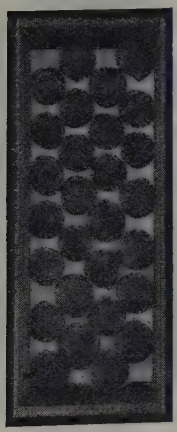
Transport.

As the whole basis of successful marketing is care, growers should follow this principle right to the finish of their share of the handling. Remember, good packing, fancy labels, wiring, or stencilling will not sell bad fruit. All the care taken in putting up a first-grade, attractive package will be of no avail if growers, while carting the fruit to the station and loading into the trucks, do not handle it carefully. Too often we see carters sitting in the middle of packed cases of fruit while on the road. Keeping the fruit covered and protected from the hot sun when on lorries and in railway trucks is necessary. Coolness at all stages is essential. Even good packing will not stand abuse, so in closing I would urge every grower to handle his fruit from the tree to the rail or market as carefully as he would handle a basket of eggs.

HOW TO PACK THE DUMP HALF-BUSHEL CASE.

2-2 Pack.

First Layer.



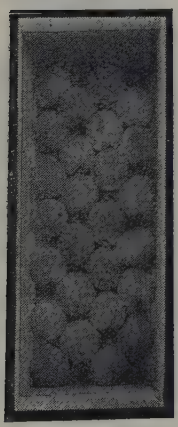
2-2 Pack, 7 x 7 Layer Count.
5 Layers. 140 Count.

Finished Case.
Side Top



140 Count.

First Layer.



2-2 Pack, 7 x 6 Layer Count.
5 Layers. 130 Count.

Finished Case.
Side Top



130 Count.

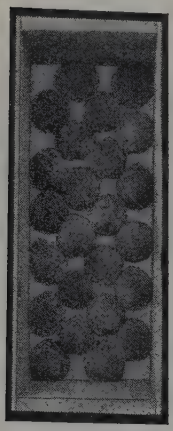
Observe the alignment of the fruit, from end to end, across, and diagonally in the case.

Plate 301.

PACKING THE DUMP HALF-BUSHEL CASE.

2-2 Pack.

First Layer.



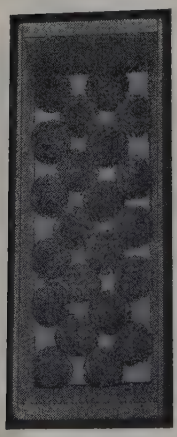
2-2 Pack, 6 x 6 Layer Count.
5 Layers. 120 Count.

Finished Case.
Top Side



120 Count.

First Layer.



2-2 Pack, 6 x 5 Layer Count.
5 Layers. 110 Count.

Finished Case.
Top Side



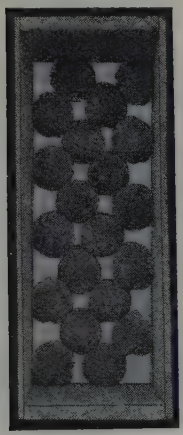
110 Count.

Observe the alignment of the fruit.
Plate 302.

PACKING THE DUMP HALF-BUSHEL CASE.

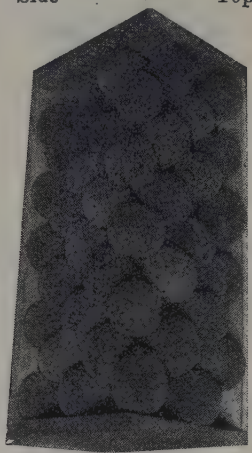
2-2 Pack.

First Layer.



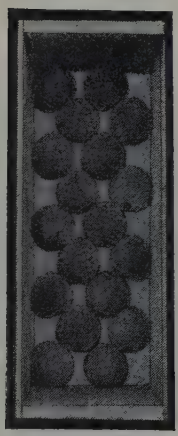
2-2 Pack, 5 x 5 Layer Count.
5 Layers. 100 Count.

Finished Case.
Side Top



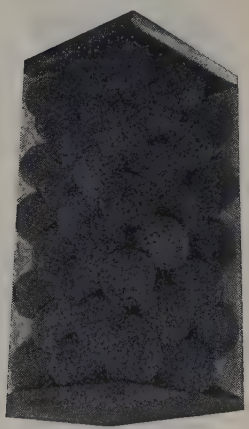
100 Count.

First Layer.



2-2 Pack, 5 x 4 Layer Count.
5 Layers. 90 Count.

Finished Case.
Side Top



90 Count.

Observe the alignment of the fruit.

Plate 303.

How to Pack the Dump Half-bushel Case.

2-1 Pack.

First Layer.



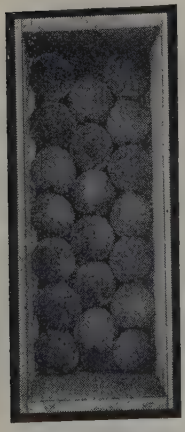
2-1 Pack, 7 x 7 Layer Count.
4 Layers. 84 Count.

Finished Case.
Top Side



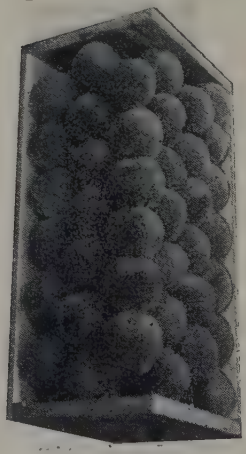
84 Count.

First Layer.



2-1 Pack, 7 x 6 Layer Count.
4 Layers. 78 Count.

Finished Case.
Top Side



78 Count.

Observe the alignment of the fruit, from end to end, across, and diagonally in the case.

Plate 304.

How to Pack the Dump Half-bushel Case.

2-1 Pack.

First Layer.



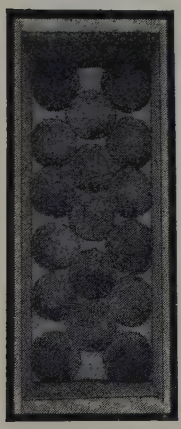
2-1 Pack, 6 x 6 Layer Count.
4 Layers. 72 Count.

Finished Case.



72 Count.

First Layer.



2-1 Pack, 6 x 5 Layer Count.
4 Layers. 66 Count.

Finished Case.



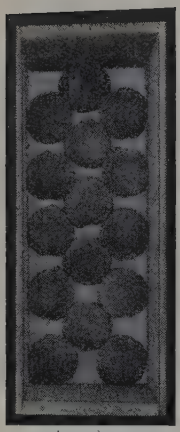
66 Count.

Observe the alignment of the fruit, from end to end, across, and diagonally in the case.

Plate 305.

PACKING THE DUMP HALF-BUSHEL CASE.

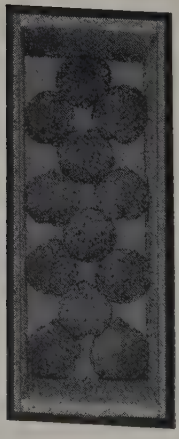
First Layers, 2-1 Pack.



2-1 Pack, 5 x 5 Layer Count.
4 Layers. 60 Count.



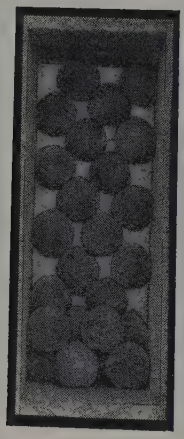
2-1 Pack, 5 x 4 Layer Count
4 Layers. 54 Count.



2-1 Pack, 4 x 4 Layer Count.
4 Layers. 48 Count.

Plate 306.

How to Start the Second Layer of the Diagonal Check Pack.



2-2 Pack.

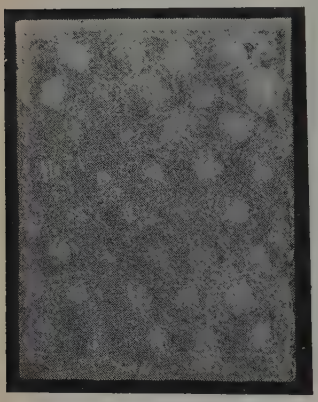


2-1 Pack.

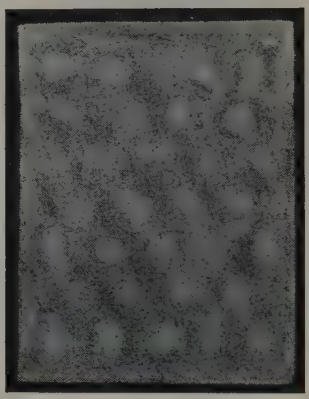
Plate 307.

Packing Peaches for Export in Trays.

18 inches long x 14¼ inches wide x 3 inches deep.



5-4 Pack. Single Layer.
36 Peaches.



5-4 Pack. Single Layer.
32 Peaches.



4-4 Pack. Single Layer.
24 Peaches.

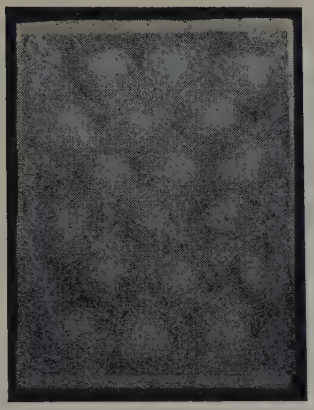
A pack containing 28 peaches can also be done with slightly smaller fruit.



4-3 Pack. Single Layer.
21 Peaches.

Note how the fruit is wrapped in sulphite wrappers and "nested" in pads of woodwool.

Plate 308.



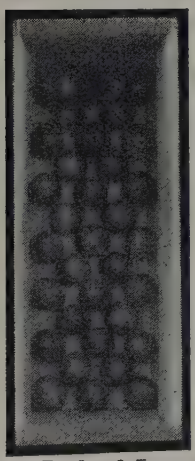
3-3 Pack. Single Layer.
18 Pack.



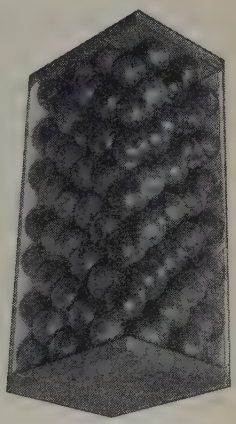
Tray finished off by placing a layer of woodwool on the top of the packed case.

How to Pack the Dump Half-Bushel Case—3-2.

NECTARINES PACKED 3–2.



3–2 Pack—6 Layers.
7 x 6 Layer Count.
195 Count.



Finished Case.
195 Count.

Plate 309.

Acknowledgment.

Thanks are due to Mr. S. Smith, of Glen Aplin, for permitting the use of his fruit for packing and photographing the packed cases and trays illustrated.

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit Culture.

AGAIN, unfortunately, we have to comment on the continued dry weather. The quality of fruit has fallen off, causing big discrepancies in prices, as with tomatoes, for instance, for which prices are ranging from 1s. 6d. to 10s. Prices on the various markets during the last week of October were:—

TROPICAL FRUIT SECTION.

Papaws.

Brisbane: Locals, 2s. 6d. to 4s. a bushel; Yarwun, 6s. 6d. to 8s. 6d. a tropical fruit case.

Melbourne: 9s. to 12s. per tropical case; special coloured higher.

Sydney: 6s. to 12s. per tropical case.

Only solid partly coloured fruit should be sent to southern markets.

I heard of a grower who has been picking his fruit green and leaving it in the heat, covered with bags, to push forward the ripening. This will only ruin the quality of the fruit so far as flavour, texture, and keeping are concerned. If difficulty is found in handling the crop, at least, keep the fruit cool if it is necessary to harvest fruit early.

Granadillas.

Few specimens of this fruit are being seen. The hot, dry weather renders it necessary to exercise extreme care when sending from the far north.

Mangoes.

These are coming on the market in increasing quantities. Prices have eased a 1s. per case. There is still room for a big improvement in harvesting and packing methods, in most cases no effort is made to protect the fruit. Growers considering sending mangoes to southern markets must remember that buyers there do not want the common type of fruit. Fruit removed from the trees with sticks, causing bruises is not popular. Prices will quickly decline if growers continue to send along green fruit.

Brisbane Prices: 6s. to 8s. a bushel.

Pineapples.

There is a great demand for good pines as supplies to market have been short.

Prices—

Brisbane Smooths: 7s. to 11s. 6d. per case; 2s. to 8s. per dozen.
Ripleys, 10s. to 14s. per case; loose 3s. to 8s. per dozen.

Melbourne: 12s. to 16s. per case.

Sydney: 8s. to 12s. per case.

Selecting fruit a little less advanced in maturity than for the last few months when sending south is now necessary. Be sure to cool all fruit before packing. Woodwool instead of grass is more than ever necessary as a packing material.

Bananas.

The dry weather is affecting quality. Prices:—

Cavendish—

Brisbane: Nines and Eights 8s. to 12s. 6d. per case; Sevens 4s. 3d. to 11s. per case; Sixes 4s. 6d. to 9s. 6d. per case, 1¾d. to 6d. per dozen; Lady Fingers 2¾d. to 5¾d. per dozen.

Melbourne: Eights and Nines 14s. to 15s.; Sevens 12s. to 13s.; Sixes 10s. to 11s., a few lines higher.

Sydney: Nines and Eights 16s. to 19s.; Sevens 14s. to 16s.; Sixes 12s. to 14s.

Growers are recommended to take as many precautions as possible to keep the fruit covered and free from sunburn or bleaching. Cool thoroughly before packing, and now the hot weather has arrived tear the side papers to allow the fullest benefits from air circulation.

Passion Fruit.

High values are ruling on all markets up to 20s. per half bushel on the southern markets, and 18s. in Brisbane being realised during the month.

Brisbane: 6s. to 18s. per half bushel.

Sydney: 8s. to 20s. per half bushel.

Melbourne: 12s. to 18s. per half bushel.

Owing to the dry spell causing bad setting and dropping these prices should be maintained for some considerable period.

CITRUS FRUITS.

Oranges.

Queensland growers have now practically finished marketing this season's crop of oranges. Supplies are now coming in from New South Wales.

Prices, Small, 4s. to 6s., Choice, 7s. to 8s.

Lemons.

Lemons are not selling as freely as the weather would indicate. One is reluctantly compelled to conclude that the increase in Malted Milk consumption is having an effect on the sales output. Only cured lemons are wanted on the market. Local, 4s. to 8s. per bushel; Gayndah, 9s. to 11s. 6d.

Tomatoes.

Supplies of good lines are short. A wide discrepancy in the prices gives a good indication of actual market conditions and the struggle on the part of some growers to obtain a return for their labours.

Brisbane: Ripe, 1s. 6d. to 4s.; Coloured, 4s. to 9s.; Green, 3s. to 6s.

There is still, by far, too much green fruit coming on to the market.

Melbourne: Large supplies of Adelaide and West Australian fruit have dropped prices. Green, 6s. to 8s., repacked to 10s.

Sydney: Queensland fruit, 4s. to 9s.

Brisbane is well worthy of consideration as the best market at present as prices for good fruit compare more than favourably with other markets and the risk of damage, to any extent, in transit is not run.

Stone Fruits.

Cherries have made their appearance on the market and are selling at good prices, up to 16s. per case being realised for Stanthorpe and New England fruit. When packing these and other stone fruit every care must be taken to guard against Brown Rot infection. Cool the fruit in a clean place and use only new cases is sound advice.

Apples.

Southern apples are selling well on the Brisbane market:—Victorian Jon., 2½-2¾, 11s. to 12s.; Rokewoods, 7s. to 10s.; G. Smith, 12s. to 15s.; Democrat, 10s. to 12s.; Yates, 8s. to 12s. for 2½.

Southern growers would do well to discontinue the sending of Jonathans over 2½ inches to Queensland. Rome Beauty are also now a very risky variety to send. Many lines of fruit would arrive in better condition if corrugated cardboard liners were used on top, bottom, and sides of the cases.

Cucumbers.

Brisbane, 6s. to 9s. Sydney, 6s. to 10s. Melbourne, 12s. to 16s. a bushel.

Lettuce.

Five pence to 1s. 6d. per dozen. Greater use could be made of boxes for marketing.

Beans.

Brisbane, 10s. to 16s. per sugar bag. Sydney, 9s. to 11s. a bushel case.

There is a good demand in Brisbane for all green vegetables.

FRUIT TRAIN CHANGES.

The Committee of Direction of Fruit Marketing has announced that the fruit trains will commence running on 23rd November, both on the main line and the Amiens line, and the first Sunday train will commence on 29th November on both lines. Fast fruit trains will run each Tuesday from Roma Street to North Queensland until 29th December. Commencing in the New Year the Tuesday fast train to the North will be cancelled, and in place of it two fast trains weekly will leave Roma Street for Northern centres each Monday and Wednesday, commencing on 4th January. The Amiens branch line will have four trains a week.

The general manager of the Queensland Railways intends to use only CLF and Jumbo CLF wagons on the Northern fast fruit trains, which will start from Roma Street and will not be sent to the Granite Belt.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advance Register of the Herd Books of the Australian Illawarra Shorthorn Society and the Jersey Cattle Society, production charts for which were compiled during the month of September, 1936 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORN.				
MATURE COW (OVER 5 YEARS), STANDARD 350 LB.				
Springleigh Primrose	Moller Bros., Springleigh, Boonah	13,767·5	647·641	Kelston Warrior
JERSEY.				
MATURE COW (OVER 5 YEARS), STANDARD 350 LB.				
Kelvinside Roseleaf	P.J. McCantey, Neurum	6,032·95	370·057	Benedictine's Perfection of Kelvinside
SENIOR, 3 YEARS (OVER 3½ YEARS), STANDARD 290 LB.				
Kensington Fairy Queen	Miss. J. Nolan, Lindum	6,937·79	357·451	Trinity Recompense
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD 230 LB.				
Blossom of Hillsdale	F. W. Hohman, Gowrie Junction	5,438·6	259·048	K.C. of Rosedale

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Berrigan.

A. M. H. (Chinchilla)—

The specimen represents *Eremophila longifolia*, the Berrigan, quite a handsome shrub or small tree fairly widely distributed in New South Wales and Queensland. It is not known to possess any poisonous or harmful properties, and is generally looked upon as a useful fodder.

A Dangerous Plant—*Cestrum Parqui*.

INQUIRER (Booval).

The specimens you send from a paddock in Booval have been determined as from *Cestrum Parqui*. This plant is poisonous to stock. According to Steyn in "The Toxicology of Plants in South Africa," the leaves contain a toxic alkaloid parquin, which has a bitter taste. Steyn further states that the actions of parquin are similar to those of strychnine and atriphine, and that the course of the disease is rapid, with the result that treatment is impossible. Cases of apparent poisoning by this plant have been recorded in which the cows were normal at the night milking and were dead next morning.

Plants from the South-West Identified.

W. D. (Goondiwindi)—

The specimens have been determined as follows:—

(1) *Agropyron scabrum*, wheat grass.
(2) *Thellungia advenaa*, coolibah grass.
(3) *Thellungia advena*.
(4) No seed heads.
(5) *Daucus brachiatus*, native carrot.
(6) *Panicum prolutum*, coolah grass.
(7) *Dichanthium sericeum*, blue grass.
(8) *Astrebla lappacea*, curly mitchell grass.
(9) *Geranium dissectum*, wild geranium.
(10) *Eragrostis setifolia*, a love grass.
(11) *Oxalis corniculata*, sorrel.

Daucus brachiatus (5), is the true native carrot as it belongs to the same genus, Daucus, as the cultivated carrot. The name native carrot or wild carrot is applied to a number of weeds with finely divided leaves in Queensland.

Geranium dissectum (9), the wild geranium, is often called wild carrot. It possesses a large fleshy root much relished by sheep.

Eragrostis setifolia (10), love grass, is also called "never fail," a name, however, applied to several grasses in Queensland.

Oxalis corniculata (11), sorrel, is sometimes confused, particularly in its young stages with the trefoils. It possesses a very acidulous flavour, and we do not think it is of much value as a fodder.

Periwinkle.

H. P. L. (Toowoomba)—

The plant forwarded is *Vinca major*, the periwinkle. The name periwinkle is more often applied to this than it is to the pink or white variety that was mentioned in this Journal, namely *Vinca rosea*. *Vinca major*, as far as known, does not possess any of the properties of the other species. It—the blue species—is common in cooler climates, the pink in warm.

General Notes

Staff Changes and Appointments.

Mr. C. R. Mulhearn, B.V.Sc., Government Veterinary Surgeon, Department of Agriculture and Stock, has been appointed Acting Director, Animal Health Station, Townsville.

Mr. E. C. Olive, Dairy Instructor, has been transferred from Maryborough to Toowoomba, and Mr. C. L. Moran, Dairy Instructor, from Toowoomba to Maryborough.

Constables C. H. Coop, R. W. G. Lake, and L. McErlean, of Jondaryan, Gilliat, and Goodna, have been appointed also Inspectors under the Slaughtering Act.

Mr. R. W. Mungomery, Assistant Entomologist, Bureau of Sugar Experiment Stations, has been appointed Entomologist, Bureau of Sugar Experiment Stations, Department of Agriculture and Stock.

The following transfers of inspectors under the Stock, Dairy, and Slaughtering Acts, Department of Agriculture and Stock, have been approved:—Messrs. J. T. Smallhorn, from Miles to Coolangatta; H. B. Ford, from Ravensbourne to Miles; T. K. Kelly, from Toowoomba to Ravensbourne; J. W. Moy, from Brisbane to Toowoomba; C. C. Sewell, from Willowburn to Ayr; A. Dick, from Ayr to Willowburn.

Mr. T. Mee, Court House, Ayr, has been appointed Chairman of the Inkerman, Invicta, Kalamia, and Pioneer Local Sugar Cane Prices Board, vice Mr. A. M. Taylor, transferred.

Mr. D. J. Kearney, Mining Registrar, Cloncurry, has been appointed also an Acting Stock Inspector.

Messrs. H. G. Selby, J. H. Edgerton, O. Denaro, C. Oliveri, J R. Gill, P. Riordan, L Ballini, jun., and E. Beccaris, of Mourilyan, have been appointed Honorary Rangers under the Animals and Birds Acts

Mr. R. H. Allen, Innisfail, has been appointed Chairman of the Goondi, Mourilyan, South Johnstone, and Tully Local Sugar Cane Prices Boards, vice Mr. W. Rillie, transferred.

Constable T. W. O'Brien, Millaa Millaa, has been appointed also an Inspector under the Slaughtering Act.

Bureau of Sugar Experiment Stations Advisory Board.

Regulations have been issued under the Sugar Experiment Stations Acts fixing the remuneration payable to members of the Sugar Experiment Stations Advisory Board, other than the two Government representatives, at £8 6s. 8d. per month, and providing for the appointment of a successor when the office of a member of such Board becomes vacant.

Mr. N. H. Wellard (Mossman), representative of sugar-cane growers, has been appointed a member of the Sugar Experiment Stations Advisory Board, vice Mr. W. D. Davies, resigned.

Canary Seed Hail Insurance.

A regulation has been issued under the Primary Producers' Organisation and Marketing Acts providing that the Canary Seed Board Hail Insurance Regulations shall have no force or effect in respect of canary seed planted during the year 1936.

Plywood and Veneer Board.

Regulations have been issued under the Primary Producers' Organisation and Marketing Acts increasing the levy for the administrative expenses of the Plywood and Veneer Board from 2½d. to 3d. per hundred feet face measurement of plywood and veneer delivered between the 17th October, 1936, and the 2nd May, 1939.

Provisional Maize Board.

An Order in Council has been passed under the Primary Producers' Organisation and Marketing Acts further extending the term of the Provisional Maize Board for twelve months. The present term expired on the 14th October.

Rural Topics

The Living Future.

And she said: "I have heard it said that it was our duty to sacrifice ourselves for the men and women living in the world at the same time as ourselves; but I never before heard that we had to sacrifice ourselves for people that are not born. What are they to you? You will be dust, and lying in your grave, before that time comes." "If you believe in God," she said, "why cannot you leave it to Him to bring good out of all this evil? Does He need you to be made a martyr of? or will the world be lost without you?"

He said: "Wife, if my right hand be in a fire, shall I not pull it out? Shall I say, 'God may bring good out of this evil,' and let it burn? That Unknown that lies beyond us we know of no otherwise than through its manifestation in our hearts; it works no otherwise upon the sons of men than through man. And shall I feel no bond binding me to the men to come, and desire no good of beauty for them—I, who am what I am, and enjoy what I enjoy, because for countless ages in the past men have lived and laboured, who lived not for themselves alone, and counted no costs? Would the great statue, the great poem, the great reform ever be accomplished if men counted the cost, and created for their own lives alone? And no man liveth to himself, and no man dieth to himself. You cannot tell me not to love the men who shall be after me; a soft voice within me—I know not what—cries out ever, 'Live for them, as for your own children.' When in the circle of my own small life all is dark and I despair, hope springs up in me when I remember that something nobler and fairer may spring up in the spot where I now stand."—Schreiner, Olive, the South African novelist, in "Trooper Peter Halket of Mashonaland" (Boston, 1897), pp. 63-4.

Rural and Urban Philosophies.

Deeper, in my opinion, than the differences between individualistic or *laissez-faire* economics and socialism, deeper even than the differences between capitalism and communism, are those between rural and urban attitudes toward life. The farmer tends to think in terms of plants and animals, of birth and growth and death. The city man, on the other hand, tends to think in terms of wheels and levers and machines, or of buying or selling. Whereas agriculture is founded on life processes, particularly as influenced by soil and weather and the laws of inheritance, urban occupations are founded on manufacturing and commerce, and the activities are mostly carried on indoors. To the city child milk is associated with a bottle, not with a cow; an apple comes from a box, not from a tree; and these early impressions influence, I believe, the ideas of later life.

As a consequence the farmer's philosophy of life is primarily organic, whereas the city man's philosophy usually is mechanistic. The farmer lives in a natural world, the city man in an artificial world. Because of his occupation the farmer's thoughts are largely biological, whereas the city man's thoughts are largely physical or economic. In farming the family is the economic and social unit—it is difficult, almost impossible, to farm without a wife, and children can help with the work from about ten years of age onward. In the cities, on the other hand, the individual is the economic unit—a wife adds little, if anything, to the family income unless she works outside the home, in which case it is difficult to rear a family, and children involve expense, with little, if any, return, from birth till marriage. It costs generally two or three times as much to rear a child in the city as it does on the farm.

Perhaps because of the open air, and the contact with nature, perhaps because the farmer sees the stars at night and observes the progress of the seasons, perhaps also because of stronger family ties, farmers and farm women tend to think of the past and the future; city people, it seems to me, tend to think more about the present. Thrift has been called into question by many city people to-day; the workday, it is urged, should be shortened to six hours so that everyone will be employed, and children by some are considered a luxury to be indulged in only by people of ample means. Granting that parents should feel a keen sense of responsibility in bringing children into the world, the fact remains that the philosophy of life which is popular in the cities to-day leads to the disintegration of the family and to national and social decay.—From "Farming as a Life Work," U.S.D.A. Ext. Ser. Cir. 244, by Baker, O. E., October, 1935, p. 6.

Treatment for Milk Fever.

Since the discovery of udder inflation for the treatment of milk fever, this disease has had few terrors for the dairy farmer, but it is considered that a few notes on it, describing the precautions to be observed in udder inflation, some of the undesirable consequences that may follow, and recent advances in treatment, may be of interest.

Usually the condition has been present some time before treatment is applied, and the affected beast will be down and more or less unconscious.

The udder should be wiped clean with a clean damp rag, and then a clean towel should be placed under the udder to prevent contamination of the organ from the soil. The beast should then be propped up on its breast bone in as natural a position as possible, taking care that the hind legs are in a normal position and not causing undue pressure to be exerted on the udder. In very advanced cases, this may not always be possible but it should be attempted.

Strip the udder of any milk present and then commence inflation with a teat syphon. Each quarter is inflated firmly and the teats are tied off at the bottom with clean tapes to prevent the escape of air. The udder should then be gently massaged to fully distribute the air throughout the organ. The tapes should be removed about half-an-hour after their application. If no improvement is noted after three hours the inflation should be repeated. The most undesirable after effect that may follow treatment by udder inflation is mammitis. To avoid this the following precautions must be observed:—

(1) The teat syphon used should be thoroughly sterilized before use by boiling.

(2) Take every precaution during inflation that the teat syphon does not come in contact with any contamination; should it occur, immerse the syphon in boiling water before continuing its use.

The above precautions are against the possibility of introducing any infection into the healthy udder.

(3) If a quarter of a cow being treated with milk fever is affected with mammitis, or has been so affected at any time, that quarter should be the last inflated, and following use on that quarter, the teat syphon must be thoroughly sterilized by boiling before being used again.

The necessity for such a precaution is obvious.

Despite the fact that the majority of beasts treated by udder inflation record an uneventful recovery, it has been found that better results are obtained by the subcutaneous (under the skin) injections of a substance known as calcium boro gluconate. It is well known that in milk fever the calcium content of the blood drops considerably and the injection of calcium boro gluconate aims at restoring the lost calcium balance. In addition to being a more convenient treatment, other advantages it possesses over udder inflation are that there is no risk of introducing or spreading mammitis, recovery is more rapid, relapses are less likely to occur, and the method may also be used as a preventive. The drug is put up in convenient form commercially, and the local chemist will be able to advise where to get it.

The drug is usually issued in cartons containing 2½ oz., the contents are dissolved in 10 oz. of hot water recently boiled and then allowed to cool to body temperature before use.

The dose given is sufficient for one treatment, and should be injected under the skin at various parts of the body—do not inject all the solution in one place. The usual precautions are taken regarding sterilization of the syringe and needles, and antiseptic precautions at injection.

It has been found that repetition of the dose is rarely necessary.

Some cows are known to be more subject to milk fever than others, and in such cases it has been found advisable to give an injection immediately after calving, followed by a second injection about twenty hours later. For these injections, the dose should be half that used for curative treatment.

Whatever the method of treatment adopted, it is advisable to cover the animal with a rug, and in no circumstances should the beast be drenched, as, owing to the paralysis extending to the throat, the cow is unable to swallow, and any liquid forcibly given will find its way to the lungs and set up a penumonia that almost invariably proves fatal.

When the treated cow gets to her feet, it is advisable that some definite form of after treatment should be adopted. The udder should not be interfered with for at least twelve hours after the cow has risen, and milking "dry" must be avoided. Small quantities of milk should be drawn off at frequent intervals on the following day, and the diet should be restricted.

Sheep Nasal Fly.

During the spring and summer months, graziers in many parts of the State may be puzzled for an explanation as to why their sheep, for no accountable reason, suddenly gallop round the paddock or stand in bunches with their faces buried in each other's wool or held very closely to the ground. If such a group is closely watched the attitude of the animals will be seen to be due to the presence of a somewhat drab, stout, greyish fly, which is frequently to be observed during this time of the year resting on the fly screens and water tanks around the homestead. This is the sheep nasal fly, which lays its maggots on the edges of the nostrils of the sheep. The reason for the animal's endeavour to protect its nose by burying it in its neighbour's wool or in the soil is therefore readily understood.

These maggots, after they have been laid by the female, crawl up the sheep's nostrils and into the communicating cavities. Here they remain for several months. Being provided with a pair of stout hooks in the region of the mouth, they attach themselves to the lining of the nostrils and cause the secretion of much pus-charged mucous, on which they feed. The condition in sheep knows as "snotty nose" is due to the presence of these maggots, which may also be responsible for such a severe irritation that the infested animal loses condition.

Control of the sheep nasal fly is not at present very effective, but much good can be done by daubing the animals' noses at frequent intervals with stockholm tar. This procedure should be especially carried out during the period October to January, when the flies are most numerous.

Field Peas Sold as Peas for Human Consumption.

Following complaints made to the Department of Health and Home Affairs with respect to the fact that certain peas sold for human consumption turned black on cooking, investigational work was carried out and the following summarises the conclusions arrived at.

Eating peas, when boiled in water containing bicarbonate of soda—apparently a common practice—may be partially disintegrated if very young, but they do not change colour.

Field peas, when boiled in water containing bicarbonate of soda, turn black or nearly black in colour.

Pea growers are therefore warned not to forward to market, for human consumption, any peas picked from plants bearing coloured flowers (field peas). Only peas picked from plants bearing white flowers (eating peas) are likely to meet with approval for this purpose.

Control of White Louse of Citrus.

White louse of citrus occurs throughout the State, and although temperature does not appear to be an important factor determining its abundance, there seems to be reason for believing that it prefers dry climatic conditions. All portions of the tree are subject to attack, but infestation generally starts on the trunk near ground level and spreads upwards. The male scales are a very conspicuous white colour, and as they are much more numerous than the female scales, a colony of this species produces a white appearance on the infested surface which has led to its being given the quite appropriate name of white louse.

It is not a difficult insect to control, but growers should remember that vigorously growing trees are much less susceptible to attack than trees in poor health. The health of infested trees should, therefore, be attended to in order to reduce susceptibility, and whatever adverse factor is impairing their health should be eliminated so far as practicable.

Spraying with lime sulphur or resin-caustic soda-fish oil gives a very good control of white louse. Control is generally best accomplished by spraying in the late winter just before blossoming, using lime-sulphur at a strength of one to twelve. The preference for lime-sulphur is based very largely on the fact that its application is attended by other beneficial results in addition to establishing control of white louse.

When the correct time for spraying has arrived certain late-maturing varieties, e.g., the Valencia Late, may still be carrying fruit. This does not really matter very much because usually only the inside parts of the tree require spraying. However, should the harvesting of the crop have been completed, then it is desirable that the whole tree be sprayed.

Fumigation with hydrocyanic acid gas also gives a good control of the white louse, and can be employed against it when conditions render fumigation practicable.

The Brown Vegetable Weevil.

During the months of July, August, and September mainly, the plants in market and home gardens are liable to attack by a small insect known as the brown vegetable weevil. The plants principally affected are the vegetables, including beetroot, carrot, lettuce, mint, potato, radish, tomato, turnips, and watercress; tobacco seedlings and cineraria have also been recorded as hosts and among the weeds the insect feeds mainly on the cape weed. Both the larval or grub stage and also the adult weevil feed on the plant tissue, while the pupal stage occurs in the soil. The larva, when full grown, is pale green in colour with a brown head, soft bodied, and about half an inch in length. The adult is a small weevil about one third of an inch long, brownish in colour, usually with a paler oblique stripe on each wing cover, forming a wide V-shaped mark on the back. The head is produced into a trunk or snout typical of the weevils.

The adults feed mainly by night, sheltering in the soil during the day, but the grub stage remains on the foliage, usually on the under side of the leaves, or sheltered at the leaf bases. The insects injure plants such as potato, tomato, tobacco, and lettuce by chewing holes into the leaves, and in cases of extreme infestation cause complete defoliation. On the tuberous root crops, such as carrots, turnips, and radishes, as well as the ordinary foliage injury, the insects feed on the young centre growth, and also burrow into the tops of the fleshy roots. Where infestation is heavy the tuberous roots may be riddled.

Control of the insect on crops such as potatoes may be obtained by the use of arsenate of lead, applied either as a spray or as a dust. Similarly, young tuberous crops may be so treated *in the early stages*. Difficulty, however, arises with the tuberous crops as they grow, and likewise at any stage in the growth of plants such as lettuce, owing to the danger from any poisonous residue of the insecticide. A generall practice in these cases is to apply a bait, the attractant being the cut tops of plants such as tomatoes that have passed the productive stage, or cape weed. This plant tissue may be dipped in an arsenate of lead solution or dusted with arsenate of lead powder, and it is then distributed among the plants to be protected. Preferably, the cut tops should be partly buried at intervals between the crop rows, the distribution taking place in the late afternoon. Old plants or weed growth in which the insects are breeding or sheltering should be cleaned up and destroyed, and infested ground should be cultivated during the winter and spring at a time chosen so as to disturb and destroy as many pupæ as possible.

Farmers' Wool Scheme.

It is felt that the benefits to be derived by the owner of small flocks from the farmers' wool scheme are not sufficiently recognised and made use of. Briefly described, it is an endeavour to get full market values on behalf of the farmer for parcels of wool which, if sent straight to the brokers in bags, butts, and bales would be sold either as star lots, or, in the case of bags, by private treaty. The Department receives wool from farmers owning less than 1,500 sheep, and for a small charge classes it into lines of similar wool, thus getting the farmers' lines into the big catalogues and participating in the competition of all buyers.

At last February's sale in Brisbane the average price for 50,000 bales was 14.9 pence per lb., a consignment of farmers' wools numbering 107 bales, classed and sold by the Department, averaged 14.8 pence per lb. When it is understood that wool arrives in bags, butts, fadges, &c., the value of this scheme to the small grower should be readily realised. As it is sometimes necessary to hold wool for considerable periods, an advance of 60 per cent. of the estimated value of the wool is paid to farmers, without interest, on receipt into store. With the exception of removing wet stains and keeping locks and bellies separate, no treatment of the wool by the farmer is necessary. The whole of the skirting and classing is done by the Department.

Banana Marketing.

In the fruit market at present it is noticeable that immature bananas are being sent from many centres. The higher prices prevailing just now, no doubt, are an inducement to market immature fruit. Growers are advised during the cooler weather to allow their bunches to hang as long as possible before cutting, in order to give the fruit every chance of filling satisfactorily.

Persimmon Varieties.

Persimmons grow and fruit exceptionally well on the Upper Tableland of North Queensland. Care should, however, be exercised in selecting suitable varieties. Whilst "Tanenashi" is undoubtedly of outstanding quality in the district its early ripening renders it susceptible to fruit fly attack. "Dia dia maru," which ripens in May, is probably one of the most suitable varieties, as in normal seasons it is sufficiently late to escape the worst period of fly incidence.

Orchard Notes

DECEMBER.

THE COASTAL DISTRICTS.

THE planting of pineapples and bananas may be continued, taking care that the ground is properly prepared and suckers carefully selected, as advised previously in these Notes. Keep the plantations well worked and free from weeds of all kinds, especially if the season is dry. New plantations require constant attention, in order to give young plants every chance to get a good start; if checked when young they take a long time to pull up and the fruiting period is considerably retarded. Small areas well worked are more profitable than large areas indifferently looked after, as the fruit they produce is of very much better quality. This is a very important matter in the case of both of these fruits, as with the great increase in the area under crop there is not likely to be a profitable market for inferior fruit. Canners only want first-class pines of a size that will fill a can, and cannot utilise small or inferior fruit, except in very limited quantities, and even then at a very low price. Small, badly filled bananas are always hard to quit, and with a well-supplied market they become unsaleable. Pineapple growers, especially those who have a quantity of the Ripley Queen variety, are warned that the sending of very immature fruit to the Southern markets is most unwise, as there is no surer way of spoiling the market for the main crop. Immature pineapples are not fit for human consumption, and should be condemned by the health authorities of the States to which they are sent.

Citrus orchards require constant attention; the land must be kept well worked and all weed growth destroyed. Spraying for scale insects should be carried out where necessary. Spraying with fungicides should have already been carried out where necessary, and, except in the case of a heavy infestation with black spot or brown spot of the Emperor mandarin, no further applications of copper sprays should be required. A close lookout must be kept for the first indications of "maori," and as soon as it is discovered the trees should either be dusted with sulphur or sprayed with lime sulphur. Borer should be looked for and destroyed wherever seen.

Early grapes will be ready for cutting. Handle carefully, and get them on to the market in the best possible condition. A bunch with the bloom on and every berry perfect will always look and sell well, even on a full market, when crushed and ill-packed lines are hard to quit.

Peaches, plums, papaws, and lemons will be in season during the month. See that they are properly handled. Look out for fruit fly in all early-ripening stone fruit, and see that none is left to lie under the trees to rot and thus breed a big crop of flies to destroy the mango crop when it ripens.

Look out for Irish blight in potatoes and tomatoes, and downy and powdery mildew on melons and kindred plants. Use Bordeaux or Burgundy mixture for Irish blight and downy mildew, and sulphur dust or lime sulphur spray for powdery mildew.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

EARLY ripening apples, plums, apricots, peaches, and nectarines will be ready for marketing during the month. They are unsatisfactory lines to handle, as the old saw "Early ripe, early rotten" applies to all of them; in fact, the season of any particular variety is so short that it must be marketed and consumed as quickly as possible. All early ripening deciduous fruits are poor carriers and bad keepers, as their flesh is soft and watery, deficient in firmness and sugar, and cannot, therefore, be sent to any distant market. The available markets are quickly over-supplied with this class of fruit, and a glut takes place in consequence. Merchants frequently make the serious mistake of trying to hold such fruits, in the hope of the market improving, with the result that, instead of improving, the market frequently becomes more and more congested, and held-over lines have to be sent to the tip. There is only one way to deal with this class of fruit, and that is to clear the markets daily, no matter what the price, and get it distributed and into consumption as rapidly as possible by means of barrowmen and hawkers. Most early ripening fruits are useless for preserving in any way, their only value being what they will bring for consumption whilst fresh. This being so, it is only a waste of time and money to forward immature, undersize, and inferior fruit to market, as it is not wanted, and there is

no sale for it. It should never have been grown, as it is frequently only an expense to the producer, besides which, unless the fallen or over-ripe fruit is regularly and systematically gathered and destroyed in the orchard, it becomes a breeding ground for fruit fly and codlin moth, as well as of fungi, such as those producing the brown and ripe rots. Early ripening fruits should, therefore, be carefully graded for size and quality, handled and packed with great care, and nothing but choice fruit sent to market. If this is done, a good price will be secured, but if the whole crop—good, bad, and indifferent—is rushed in to the local markets, a serious congestion is bound to take place and large quantities will go to waste.

Orchards and vineyards must be kept in a state of perfect tilth, especially if the weather is dry, so as to retain the moisture necessary for the development of the later ripening fruits. Where citrus fruits are grown, an irrigation should be given during the month if water is available for this purpose, excepting, of course, there is a good fall of rain sufficient to provide an ample supply of moisture.

Codlin moth and fruit fly must receive constant attention and be kept under control, otherwise the later-ripening fruits are likely to suffer severely from the depredations of these serious pests.

Grape vines must be carefully attended to and sprayed where necessary for black spot or downy mildew or sulphured for oidium.

WIDE GATES—MOVEABLE CENTRE POST.

On farms where implements of unusual width have to be moved from paddock to paddock the ordinary gate is not wide enough, to get them through. To provide extra wide gates everywhere would be inconvenient, owing to the trouble of handling such heavy gates at all times. The necessary width may be secured, however, by having two gates of ordinary width with a centre post between. This centre post, in place of being planted immovably in the ground, is so fitted that it can be taken away easily when required, and replaced in a few minutes after the implement has passed through.

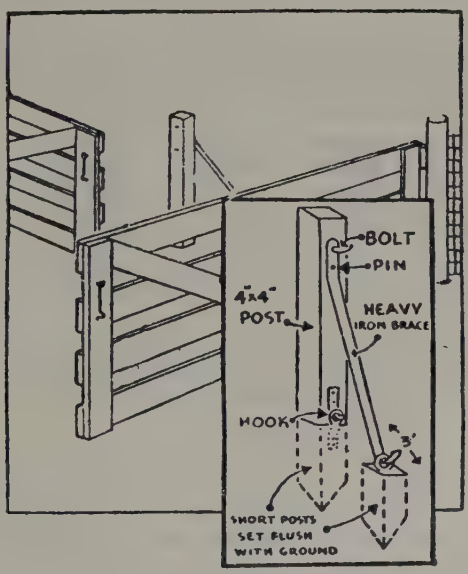


Plate 310.

Instead of a sunken oil drum filled with concrete, and with a socket moulded in the concrete to receive the post, the American farmer plants two stub posts with the tops flush with the surface of the ground, as illustrated. The centre post is squared off at the bottom and fitted with an angle hook, which hooks into an eye on the top of one of the stub posts. A heavy iron brace is fastened to the top of the movable post with a bolt and a steady-pin, the other end of the brace being curved to fit into an eye on top of the second stud post. When it is desired to open the gate to the full double width the bolt is unscrewed, when it is easy to bend the post over and unhook it from its supports. This idea was contributed by a correspondent to "The Prairie Farmer" (U.S.A.).

Farm Notes

DECEMBER.

ALTHOUGH November is regarded generally as the best period for planting the main maize crop, on account of the tasseling period harmonising later on with the summer rains, December planting may be carried out in districts where early frosts are not prevalent, provided a known quick maturing variety of maize is sown.

To ensure a supply of late autumn and winter feed, dairymen are advised to make successive sowings of maize and sorghums, to be ultimately used either as green feed or in the form of ensilage. The necessity for such provision cannot be too strongly urged. Farmers who have not had any experience in building an ensilage stack can rest assured that, if they produce a crop for this purpose, information and instruction on the matter will be given on application to the Under Secretary for Agriculture and Stock; also that, whenever possible, the services of an instructor will be made available for carrying out a demonstration in ensilage-making for the benefit of the farmer concerned and his immediate neighbours.

In districts and localities where supplies of lucerne are not available, sowings of cowpeas should be made, particularly by dairymen, as the lack of protein-yielding foods for milch cows is a common cause of diminished milk supplies and of unthriftiness of animals in dairy herds. Cowpeas and lucerne can be depended upon to supply the deficiency. The former crop is hardy and drought-resisting. When plants are to be used as a fodder, it is customary to commence to feed them to stock when the pods have formed. Animals are not fond of cowpeas in a fresh, green state; consequently the plants should be cut a day or two before use. Economy is effected by chaffing beforehand, but the plants can also be fed whole. Chaffed in the manner indicated, and fed in conjunction with green maize, or sorghum, when in head, in the proportion of one-third of the former to two-thirds of the latter, a well-balanced ration is obtainable. Animals with access to grass land will consume from 40 to 50 lb. per head per day; a good increase in the milk flow is promoted by this succulent diet. The plant has other excellent attributes as a soil renovator. Pig-raisers will find it invaluable also.

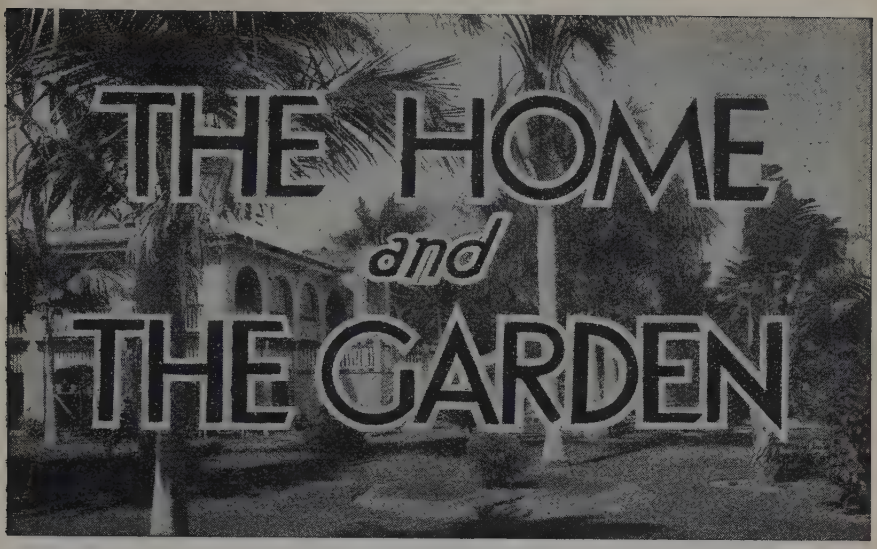
A great variety of quick-growing catch crops, suitable for green fodder and ensilage purposes, may also be sown this month, notably Sudan grass, white panicum, giant panicum (liberty millet), Japanese millet, red and white French millet. Well prepared land, however, is required for crops of this description, which make their growth within a very limited period of time. French millet is particularly valuable as a birdseed crop, the white variety being more in favour for this purpose.

Successive sowings may be made of pumpkins, melons, and plants of this description.

Cotton areas which were subjected to a thorough initial preparation, thereby conserving a sufficiency of moisture for the young plants, should now be making good headway and sending their taproots well down. Keep down all weed growth by scarifying as long as the growth will admit of horse work.

Publication Received—"The Internal Parasites and Parasitic Diseases of Sheep: Their Treatment and Control," by I. Clunnies Ross, D.V.Sc., and H. M. L. Gordon, B.V.Sc.; Angus and Robertson, 25s.

The appearance of this book will be gladly welcomed by all of those interested in the sheep industry in Australia. Both the authors are well known and are recognised as the two foremost authorities on worm diseases in sheep in this country. The matter is well put together, very up-to-date, and well printed and is chiefly concerned with the life histories and control of the various species of worms under such conditions as exist in Australia. The book is amply illustrated and the numerous photographs of the various species of worms, all natural size, greatly assist the authors' endeavour to make the matter understandable to the layman. Both the authors and the publisher are to be congratulated on the production of an excellent work which should prove a very valuable acquisition to the library of every veterinarian, stock inspector, and sheep owner.—F.H.S.R.



OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

HANDLING BABIES AND "GOOD MOTHERCRAFT."

THE writer was travelling in a public carriage and could not help observing a young mother carrying a baby, and was distressed with what she observed. The mother was accompanied by an older woman, apparently a friend. During the journey I sat near the two, so was able to watch the way the mother handled the baby, and could not avoid overhearing some remarks passed between the mother and her friend.

The baby was obviously very young; it looked to be only two or three weeks of age, and it crossed my mind the mother and baby might just then have been discharged from the nursing home; otherwise I wondered why one so young was being taken about at that hour. Also, it was a little baby; by that I mean it appeared to be smaller than the infant of average size, and might have been about 6 lb. or so in weight. What caught my attention and distressed me on the baby's behalf was the fact that the mother evidently knew so little about holding the baby or allowing it to rest. She held it upright against her, and patted it vigorously without ceasing. After many futile attempts to close its eyes and sleep, the baby protested (rather feebly, I thought), so its position was changed, but the patting continued. Fortunately for the little one, it feel asleep in spite of the treatment, and was allowed at last to rest in a comfortable position reclining on its mother's arm, when I was relieved to see that at last the patting had ceased.

It is not my intention to be critical of the young mother. She no doubt loved the baby, and the patting and caressing she bestowed upon it were the means she used to express her feeling for her infant. But she was sadly in need of some teaching in mothercraft.

No woman is a natural-born mother; she must learn her profession just as any other individual must learn the profession which they intend to follow. And why should not a mother, whose profession is above all others, learn it perfectly, and not experiment on her first baby (probably at the expense of the child's welfare), when she can so easily obtain skilled help and advice from women who have made a study of the "care of baby"? How many little babies might be spared the unnecessary sufferings inflicted upon them through ignorance under the false name of love!

When the older woman was saying good-bye to the mother as she prepared to leave the tram, after discussing how long the delay had been in getting the baby to sleep during the afternoon, she advised the mother to "pop baby right into bed when she got home and allow her to have her sleep out.' As it was then after 5.30 p.m. I wondered when the tired-looking little mite would wake for her food, and if she would have to wait for it until she did wake up.

"Rest and sleep" are certainly included in baby's essential needs, and baby must have enough of both if he or she is to grow to adult life with a sound nervous system. Remember there are 11 other essentials as well. "Food" is one and "regularity" another, and "judicious handling" yet another.

Baby must have "food" if she is to grow, and if she is small, as this baby was, and does not get sufficient food she will become more and more sleepy, with consequent loss of vitality through lack of food. Now the importance of "regularity" is that baby is trained to sleep for a definite length of time at the same hours each day, and so a rhythm is established in the daily life. The same applies to "feeding times" and all other times for doing things. Baby either wakes or is wakened for feeding at the same time each day, and so a certain number of feeds are ensured each day and a regular space of time between to allow the digestive organs to do their work and rest a little before another meal has to be dealt with.

I cannot help hoping that this article may come under the eye of the mother for whose baby I have been moved to write it, and that her love is great enough to help her appreciate the few points I have tried to make clear.

IN THE FARM KITCHEN.

RHUBARB AS DESSERT.

Rhubarb Jellies.

Half-fill some large glasses with steamed or stewed rhubarb, well chilled. Cover with a layer of custard sauce. When set, decorate with sliced banana. Make a milk rhubarb jelly from a packet of lemon jelly crystals, mixed according to instructions on packet, but using half a pint of rhubarb juice and water and half a pint of custard sauce instead of a pint of water. Turn out. Fill centre with stewed or steamed rhubarb.

Rhubarb and Sago Mould.

Take ½ lb. rhubarb, 6 oz. sugar, ¼ lb. sago, 2 cupfuls water.

First simmer the rhubarb in one cupful of water for ten minutes. Then soak the sago in the remaining cupful of water for the same time. Add sago and sugar to rhubarb, and simmer ten minutes longer. Pour into wet moulds. Turn out when set, and serve with custard sauce or whipped cream.

Rhubarb Cream.

Take 1 lb. rhubarb, 3 cloves, 1-inch length stick cinnamon, 1¼ cupfuls sugar, I cupful whipped cream, grated rind and juice 1 lemon.

Wipe and chop rhubarb, then add lemon rind and juice, cloves, and cinnamon. Place in a pan and cook until tender. Remove cloves and cinnamon. Add sugar, and continue to simmer until reduced to a thick puree. Allow to cool, then fold in the whipped cream. Serve in glasses lined with sponge fingers and place a glace cherry and leaves of angelica on top for decoration.

Sussex Rhubarb Tart.

Take 3 cupfuls rhubarb, 1 teaspoonful butter, 1 cupful castor sugar, 1 oz. flour, ½ lb. plain pastry.

Wipe and chop rhubarb into equal-sized pieces. Sift sugar and flour into a basin. Line a low pie-dish with plain pastry, and spread it evenly with half the flour and sugar. All rhubarb. Pour over remainder of flour and sugar. Dab with butter. Brush edges of pastry with cold water, then place pastry cover on top. Decorate and bake from forty to forty-five minutes in a quick oven.

Rhubarb Flan.

Take 6 oz. short pastry, 3 cupfuls sliced rhubarb, 1 cupful castor sugar, ¼ oz. gelatine, 2 tablespoonfuls cornflour.

Roll pastry to one-eighth of an inch thickness, and line a greased pie plate, or sandwich tin, neatly. Ornament the edges and prick bottom with a fork. Mix the cornflour lightly with rhubarb, then stir in sugar. Cook in a double boiler till tender. Drain and arrange in pastry case. Bake in a hot oven for fifteen to twenty minutes, then reduce the heat and finish cooking. Dissolve gelatine in syrup. When beginning to set, pour over the fruit.

Rhubarb Meringue.

Take 1 lb. rhubarb, 8 oz. castor sugar, 4 eggs, 1 lemon.

Steam chopped rhubarb with half the castor sugar until tender. Strain off the juice into a bowl, and rub through a wire sieve. Return juice to pan and simmer down to a gill, then add to the rhubarb puree. Mix in the lightly-beaten egg-yolks, and add grated lemon rind. Pour the mixture into a fireproof dish, and bake for half an hour. Beat the egg-whites to a stiff froth, fold in remainder of castor sugar, and spread this evenly over the baked sweet. Return dish to the oven until the meringue is set.

Scalloped Rhubarb

Take 3 cupfuls rhubarb, 1 cupful castor sugar, 2 cupfuls soft breadcrumbs, 1 lemon, ¼ teaspoonful grated nutmeg, ¼ cupful water, 2 tablespoonfuls fresh butter, ¼ teaspoonful ground cinnamon, grated orange rind to taste.

Melt the butter and mix with the crumbs, mix sugar, spice, grated lemon rind, and orange to taste. Put quarter of a cupful of crumbs in the bottom of a fireproof dish, then add half the rhubarb. Sprinkle with half the spiced sugar, then cover with another quarter of crumbs. Put in remainder of rhubarb, sprinkle with remainder of spiced sugar, mix together lemon juice and water or half lemon juice and half orange juice and water, sprinkle over dish, put remainder of buttered crumbs on top, cover closely. Cook three-quarters of an hour in a moderately hot oven, then uncover and brown quickly.

Rhubarb Custard Pasty.

Take ½ lb. shortcrust, 2 level tablespoonfuls cornflour, ¼ teaspoonful salt, 2 tablespoonfuls cold water, 2 cupfuls rhubarb, 1 cupful boiling water, 1 egg, 1 cupful sugar.

Mix the cornflour to a smooth paste with the cold water. Add boiling water. Cook until mixture thickens. Stir in rhubarb, chopped very fine, and stir occasionally until mixture boils. Cover and allow to cool. Line a deep pie-dish with the short crust. Beat an egg until light, then beat in sugar and salt. Stir into rhubarb mixture. Pour mixture into prepared pie-dish. Bake until crust is done—in about half an hour. The lighter the egg is beaten the better. If liked, the rhubarb mixture can be flavoured with lemon juice or a little preserved ginger.

Rhubarb Betty

Take 1 pint rhubarb, 1 lemon, 1 orange, 7 oz. sugar, 2 tablespoonfuls dessicated cocoanut, 5 oz. breadcrumbs, 2 oz. butter.

Wipe some rhubarb and cut it in small pieces, then measure it. Melt the butter, and mix it with the breadcrumbs. Grate the rinds of the orange and lemon and squeeze out the juice and mix it with the cocoanut. Place about one-third of the breadcrumbs in a buttered dish, add half the rhubarb and sprinkle it with half the sugar. Add half the cocoanut with the fruit rind and juice. Add another portion of breadcrumbs, and remainder of fruit, sugar, and cocoanut, then cover it with remainder of the crumbs. Cover the pudding with a buttered paper and bake it in a moderately hot oven until the rhubarb is soft, then decorate it with pieces of lightly-cooked rhubarb.

Rhubarb Ginger Pudding.

Take ½ lb. self-raising flour, 2 level teaspoonfuls ground ginger, 4 oz. suet, water to mix, ½ bundle rhubarb (or sufficient to fill the basin), 2 tablespoonfuls brown sugar, 1 level teaspoonful ground ginger.

Wipe rhubarb sticks, remove the green leaves and tips, and cut the rhubarb into short lengths. Sift the flour with 2 level teaspoonfuls of ginger. Chop the suet finely and add it, then mix all to a pliable dough with cold water. Put barely one-third of this dough aside for the top of the pudding, the remainder roll to a round shape about one and a-half times as large as the top of the pudding basin. Grease this and line it with crust. Put in half the rhubarb, then add the sugar, mixed with 1 level teaspoonful of ginger. Fill up with rhubarb, and add a little water. Roll out the remaining piece of crust and cover the pudding, dampening the edge to make it adhere. Cover it with a greased paper and floured pudding cloth. Put it into a pan of boiling water and boil for about two and a-half hours.

HAVE YOU ANY SPARE TIME?

The day's work is done, dinner is over, and you're tired. There is still an hour or so before bedtime. What will you do? Switch on the radio maybe, but sometimes you're not just in that mood. You prefer a book or something, anything, to pass the time. You pick up a magazine—light fiction, but perhaps you throw it down, with "Umph! there's nothing in that." You want to read, but still you want something that isn't a sheer waste of time. Well now, here's just the very thing that you want. Here's a series of articles brightly written that will interest you, and at the same time give you some useful information. Now isn't that what you're looking for? "What sort of information?" you say. Well, about all sorts of things. What about some history? That can be very interesting, you know, or some articles about some of the things that farmers grow—wheat, cotton, sugar-cane, and so on—and not only the things that Queensland farmers grow, but those that are grown in other countries as well. Where they are grown, how they are grown, and how they are sent to market, and where they are used. That is to say, a series of talks on what one might call, say, economic geography. Or it maybe you might like to read all about the science of horticulture.

Then what about your boy and girl just growing up, thinking of looking for a job? They would get on so much better, you know, if they could express themselves well, no matter what job they are going to take on. It would be well worth their while reading up a series of papers on "How to Speak" or "How to Write."

On all these subjects, and many others, you can obtain sets of typewritten papers, 21 on each subject, which will be posted to you two each fortnight. Along with the papers, too, you can obtain books on the same subject, and all for the cost of only 8s. 6d. Seize this opportunity, and write to-night for further information to—The Director of Tutorial Classes, corner of Edward and Ann streets, Brisbane.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF SEPTEMBER IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Sept.,	No. of Years' Records.	Sept., 1936.	Sept., 1935.		Sept.,	No. of Years' Records.	Sept., 1936.	Sept., 1935.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	0·69	35	1·89	Nil	Clermont	1·03	65	0·06	0·61
Cairns	1·64	54	4·22	0·08	Gindie	1·11	37	..	1·22
Cardwell	1·52	64	2·41	0·28	Springsure	1·33	67	0·26	3·00
Cooktown	0·57	60	0·68	Nil					
Herberton	0·55	50	0·85	0·03					
Ingham	1·55	44	3·75	0·15					
Innisfail	3·47	55	6·94	0·20					
Mossman Mill	1·50	23	7·09	0·02	*Darling Downs.*				
Townsville	0·78	65	0·21	0·03					
Central Coast.					Dalby	1·70	66	1·07	3·06
					Emu Vale	1·79	40	1·59	2·80
					Hermitage	1·60	30	..	2·99
Ayr	1·36	49	0·11	0·17	Jimbour	1·50	48	1·25	3·00
Bowen	0·82	65	0·06	0·68	Miles	1·37	51	0·89	2·97
Charters Towers	0·83	54	0·11	0·47	Stanthorpe	2·32	63	1·50	4·16
Mackay	1·58	65	1·08	2·70	Toowoomba	2·15	64	1·70	3·36
Proserpine	2·10	33	2·28	0·79	Warwick	1·84	71	1·50	3·19
St. Lawrence	1·29	65	0·08	1·00					
South Coast.									
					Maranoa.				
Biggenden	1·59	37	0·69	3·38					
Bundaberg	1·61	53	1·24	2·49					
Brisbane	2·04	85	0·84	3·49	Roma	1·44	62	0·44	2·84
Caboolture	1·89	49	0·73	3·07					
Childers	1·86	41	0·48	2·93					
Crohamhurst	2·72	43	1·09	3·81					
Esk	2·15	49	1·09	4·18					
Gayndah	1·60	65	0·55	2·01					
Gympie	2·15	66	0·07	4·10	*State Farms, &c.*				
Kilkivan	1·73	57	1·13	2·64					
Maryborough	1·98	65	0·18	3·33	Bungeworgoral	0·97	22	0·25	..
Nambour	2·58	40	0·64	4·08	Gatton College	1·59	37	1·27	2·99
Nanango	1·85	54	0·99	2·64	Kairi	0·68	22	..	..
Rockhampton	1·33	65	0·13	1·42	Mackay Sugar Experiment Station	1·51	39	0·94	3·94
Woodford	2·22	49	0·43	2·88					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—SEPTEMBER, 1936.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Atmospheric Pressure at 9 a.m. Means	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·96	83	72	85	28	61	22	68	6
Herberton	..	76	57	86	26	44	27	85	9
Rockhampton	30·12	82	59	92	21, 24	50	10	13	6
Brisbane	30·16	76	54·1	87	12	50	4, 23	84	5
Darling Downs.									
Dalby	30·13	77	46	90	24	37	22	107	5
Stanthorpe	..	68	39	80	15	27	27	150	6
Toowoomba	..	72	46	85	15	36	27	170	6
Mid-Interior.									
Georgetown	29·99	91	64	97	25	57	26	76	1
Longreach	30·07	85	54	97	24	40	17	49	5
Mitchell	30·13	77	44	89	15, 23	30	27	49	4
Western.									
Burketown	29·98	90	66	95	11, 22	56	28	Nil	..
Boulia	30·09	85	54	99	14	45	1	28	1
Thargomindah	30·14	77	49	94	14	42	9, 17, 19, 26	31	3

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	November. 1936.		December. 1936.		Nov., 1936.	Dec. 1936.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	p.m.
1	5.3	6.9	4·49	6·31	8.33	9·10
2	5.2	6.10	4·49	6·32	9.26	9·54
3	5.1	6.11	4·49	6·33	10.33	10·35
4	5.0	6.12	4·50	6·34	11.19	11·6
5	5.0	6.12	4·50	6·35	..	11·42
					a.m.	
6	4.59	6.13	4·50	6·36	12.1	..
						a.m.
7	4.58	6.14	4·50	6·37	12.39	12·15
8	4.57	6.15	4·50	6·38	1·11	12·46
9	4·57	6.15	4·51	6·38	1·43	1·17
10	4·56	6.16	4·51	6·39	2·16	1·49
11	4·56	6.17	4·51	6·39	2·45	2·29
12	4·55	6.18	4·51	6·40	3·16	3·8
13	4·55	6.18	4·52	6·40	3·52	3·53
14	4·54	6·19	4·52	6·41	4·29	4·43
15	4·54	6.20	4·52	6·41	5·11	5·37
16	4·53	6.21	4·52	6·42	5·58	6·32
17	4·53	6.22	4·53	6·42	6·49	7·32
18	4·52	6.23	4·53	6·43	7.41	8·30
19	4·52	6.23	4·53	6·43	8.36	9·30
20	4·52	6.24	4·54	6·44	9.37	10·29
21	4·51	6.25	4·54	6·44	10.35	11·26
						p.m.
22	4·51	6.26	4·55	6·45	11.34	12·28
					p.m.	
23	4·51	6.27	4·55	6·45	12.35	1·32
24	4·50	6·28	4·56	6·46	1·36	2·38
25	4·50	6.28	4·56	6·46	2.41	3·48
26	4.50	6.29	4·57	6·47	3.49	4.54
27	4·50	6.29	4·58	6·48	4·59	5·55
28	4·49	6.30	4·58	6·48	5.59	6·55
29	4.49	6.30	4·59	6·49	7.16	7·44
30	4.49	6.31	4·59	6·49	8.17	8·27
31			5·0	6·50	..	9.7

Phases of the Moon, Occultations, &c.

6 Nov.	☽	Last Quarter	11 28	p.m.
14 „	●	New Moon	2 42	p.m.
22 „	☾	First Quarter	11 19	a.m.
29 „	○	Full Moon	2 12	a.m.

Apogee, 12th November, at 7.48 p.m.
Perigee, 28th November, at 12.24 a.m.

On the 17th it will be interesting to see the Moon in crescent shape near both planets during the evening hours, with the graceful curves of Scorpio nearby. At the time of conjunction—1 p.m.—Jupiter will be only one-tenth of a degree south of the Moon, while Venus will be separated from it by 2 degrees at 9 p.m., when the planet will be too near the horizon to be visible.

On the 18th Mercury will be in superior conjunction with the Sun, when it will be at a distance of more than 137,000,000 miles from the Earth. Its brilliance will be considerably less than it was about the middle of July.

Saturn, in the eastern part of Aquarius, after a period of apparently retrograde motion, will seem to become stationary on the 20th, after which it will again resume its eastward course. At 9 p.m. on the 23rd the Moon will be 8 degrees north of this comparatively lustreless planet.

Mercury rises at 4.35 a.m., 28 minutes before the Sun, and sets at 5.19 p.m., 50 minutes before it, on the 1st; on the 15th it rises at 4.47 a.m., 7 minutes before the Sun, and sets at 6.11 p.m., 9 minutes before it.

Venus rises at 6.56 a.m., 1 hour 53 minutes after the Sun, and sets at 8.40 p.m., 2 hours 31 minutes after it, on the 1st; on the 15th it rises at 7.10 a.m., 2 hours 16 minutes after the Sun, and sets at 9.4 p.m., 2 hours 44 minutes after it.

Mars rises at 2.53 a.m., 2 hours 10 minutes before the Sun, and sets at 2.35 p.m., 3 hours 34 minutes before it, on the 1st; on the 15th it rises at 2.20 a.m., 2 hours 34 minutes before the Sun, and sets at 2.20 p.m., 4 hours before it.

Jupiter rises at 7.52 a.m. and sets at 9.35 p.m. on the 1st; on the 15th it rises at 7.7 a.m. and sets at 8.55 p.m.

Saturn rises at 2.5 p.m. and sets at 2.43 a.m. on the 1st; on the 15th it rises at 1.8 p.m. and sets at 1.48 a.m.

The Southern Cross will be at position III., as on the clock-face, on 1st November, at 4 p.m. At 8 p.m., position V., it will be too near the horizon to be visible. It will reach its lowest position, VI., before midnight during November, and will therefore be absent from the evening sky.

6 Dec.	☽	Last Quarter	4 20	a.m.
14 „	●	New Moon	9 25	a.m.
21 „	☾	First Quarter	9 30	p.m.
28 „	○	Full Moon	2 0	p.m.

Apogee, 10th December, at 6.6 a.m.
Perigee, 26th December, at 6.36 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

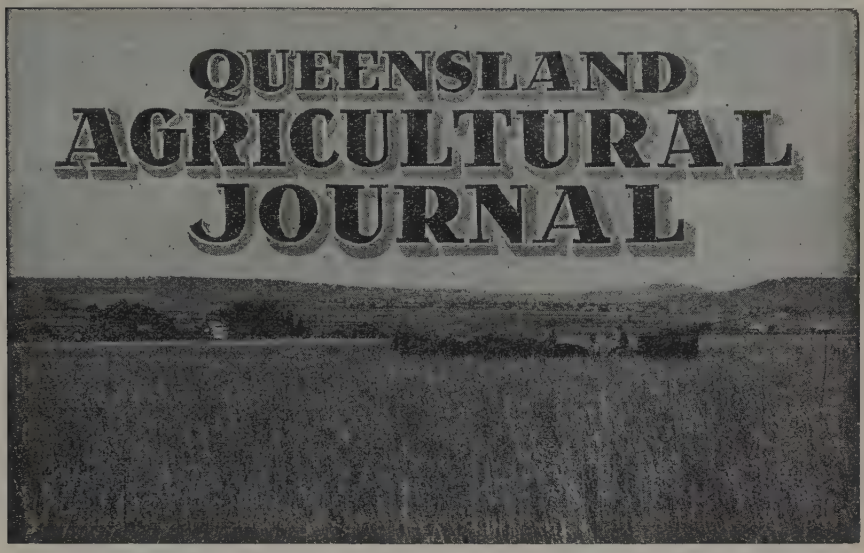
The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

[All the particulars on this page were computed for this Journal, and should not be reproduced without acknowledgment.]

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VOL. XLVI. 1 DECEMBER, 1936. PART 6

Event and Comment

Inauguration of the Faculty of Veterinary Science.

THE official inauguration of the Faculty of Veterinary Science within the University of Queensland, on 29th October, was an occasion of more than ordinary importance. Although the work of the Faculty was initiated at the beginning of March of this year, the inauguration ceremonies were delayed until October on account of the absence abroad of the Premier, Hon. W. Forgan Smith, LL.D. It is the practice of the University to mark the establishment of new faculties with an inaugural oration by the newly appointed professors, and on this occasion a notable address, which is printed in this issue, was delivered by Professor H. R. Seddon, Dean of the Faculty of Veterinary Science.

The Vice-Chancellor of the University, Dr. W. N. Robertson, presided over a large public gathering and in introducing Professor Seddon outlined his career in New Zealand, Victoria, and New South Wales, his association with University and Governmental activities in the field of veterinary science and his record of achievement in veterinary research.

The Minister for Agriculture and Stock, Hon. Frank W. Bulcock, in a brief introductory address stressed the great importance of the animal industries to Queensland, and referring to the wide variety of problems confronting us in those industries, indicated the urgent necessity for more extensive research activities in this State. The ability to meet these responsibilities, he stated, was dependent largely on the availability of highly trained graduates in veterinary science and it was the desire

of the Government that facilities for the training of Queensland students in this field should be made available. He believed that the Faculty of Veterinary Science within the University of Queensland was destined to have an important influence on the development of the animal industries of Queensland, and that it would establish for itself a high status and reputation. The Minister spoke in eulogistic terms of Professor Seddon, stating that his appointment by the Senate of the University gave him (Mr. Bulcock) deep personal pleasure, since many years ago he had come into contact with Dr. Seddon, then in charge of the Glenfield Animal Health Station, New South Wales, and had then dreamed the hope or thought that when a Faculty of Veterinary Science was founded in Queensland Dr. Seddon would be the first Professor of that Faculty. The Minister concluded by stating that through the offices of the Senate of the University he had been able to associate Professor Seddon with the work of the Department of Agriculture and Stock. Professor Seddon had been appointed as Veterinary Adviser within the Department of Agriculture and Stock, and was now engaged in organising the Division of Animal Industry.

At the conclusion of Professor Seddon's address, a vote of thanks was moved by Professor E. G. Goddard, Dean of the Faculty of Agriculture. He congratulated the Minister on the achievement of his desire to see a Faculty of Veterinary Science at the University of Queensland, and paid a tribute to the foresight and purposiveness of the Premier and the Minister in having secured for Queensland and Queenslanders an institution that should be of immense advantage to the State.

Mr. E. F. Sunners, Chairman of the Queensland Meat Industry Board, in supporting Professor Goddard's remarks, spoke of the grand opportunity that now exists for co-operative effort on the part of the Department of Agriculture and Stock, the University, the Queensland Meat Industry Board and the Council for Scientific and Industrial Research.

The Importance of the Veterinary Profession.

IN the course of his second reading speech on the Veterinary Surgeons Bill, the Minister for Agriculture and Stock, Hon. Frank W. Bulcock, made some notable references to the importance of veterinary medicine and surgery in the agricultural and pastoral economy of the State. He said:—

"We have established a veterinary school in Queensland, and shall turn out our own veterinarians, and I venture the opinion that the hardships imposed on stockowners who desire to bring stock from New South Wales will be very largely removed, particularly in view of the fact that what appears to be an indication of the standardisation of treatment in respect of pleuro-pneumonia will soon become an accomplished fact.

"There is probably no profession in Australia nor in the world that has made such progress during the last decade as that of the veterinarian. Listening to the inaugural address of Professor Seddon at the ceremony of the establishment of the Faculty of Veterinary Science within our own University, entitled 'Animal Health in Queensland,' I was surprised to learn that in the United States of America there are 10,000

qualified practising veterinarians. That fact is rather significant, as America is apparently the home of the motor-car. It is also remarkable to note that of this number 3,000 are employed by one research organisation. If one research organisation alone in America regards the value of veterinary science as justifying the employment of that number of men, surely we in Queensland can afford to accept our responsibilities in regard to the control of the profession here! . . . .

". . . . There is now a general recognition of the value of stud stock breeding. To-day, people will not take the risks that they were prepared to take a few years ago.. . . I say frankly that if I could provide double the veterinary service that I am able to provide at the present time, that duplicated veterinary service would be fully employed, because there is a recognition on the part of the stockowner that the veterinarian has a definite place in his practice of flock or herd management."

Proposed Commodity Pool Merger.

A SUGGESTION for the consideration of the possibility of marketing farm products more economically was made by Mr. E. Graham (Under Secretary, Department of Agriculture and Stock and Director of Marketing) in the course of his annual report to the Minister (Hon. Frank W. Bulcock), and which was recently presented to Parliament. Mr. Graham said:—

"From the operations of pools over a number of years there emerges the desirability of arranging for the amalgamation of several of the existing pools under one board, and in this connection I commend to the consideration of growers the desirability of the formation of a cereal pool to be constituted under the Primary Producers' Organisation and Marketing Acts and which would function in respect of the marketing of cereals and seeds comprising wheat, canary seed, barley—for which commodities pools are already in existence—and later, possibly maize and setaria (known locally as panicum seed) grown in Southern Queensland.

"These commodities have many features in common, and for the greater part they are produced in the same tract of country, and it is reasonable to surmise that the products would be controlled and marketed more economically by one board and a central organisation than is possible at present, when there are several pool boards operating. No doubt a strong case could be set up in favour of the amalgamation of these and possibly some other pools now functioning as independent entities. An amalgamation would not deprive any particular industry of its prestige, but would pave the way towards improvement in the efficient and economical functioning of the pools. The matter of the coalition of several of the pool boards is thought to be worthy of very careful consideration and, I think, the endorsement of growers. It is to be mentioned that provision exists under the Primary Producers' Organisation and Marketing Acts to enable the boards to effect amalgamation.

"The principal factors in carrying the amalgamation into fruition would be the agreement of the growers as to the advisability of such action, and the preparedness of the boards to appreciate that the amalgamation may be necessary in the best interests of the industries concerned; and that these interests should be regarded as of paramount importance, while the preservation of the identity of any particular board should be made a matter of secondary consideration."

The Cotton Web-spinner.

W. J. S. SLOAN, B.Sc.Agr., Assistant Entomologist.

THE cotton web-spinner, *Loxostege affinitalis* Led., was first observed in the Callide Valley five years ago. Until the close of the last season, however, the damaged plants have normally been weeds, though occasionally cotton stands have been lightly affected. In the 1932-33 season, T. H. Strong, who was then on the entomological staff of this Department, reported light attacks of the pest on cotton from invading larvæ which had bred up on nearby weed host plants in November and February. In the 1935-36 season, however, quite serious losses of seedling cotton were experienced as a result of the abnormal population of the pest which developed in several districts. Two very distinct broods of larvæ occurred—one in the first half of October, 1935, and one at the end of January and in early February, 1936. Due to irregular weather conditions prevailing during the 1935-36 cotton season, the crop was spread over a number of plantings, so that seedling cotton was present at the time of each heavy brood.

Distribution in Cotton Districts and Elsewhere.

The first outbreak of the pest in the 1935-36 season was confined mainly to the Callide and Dawson Valleys, with the exception of a small infestation in a field of cotton at Mundubbera. With the second distinct brood, heavy larval populations also occurred in the Upper Burnett.

A small number of records of this insect, in addition to the one already mentioned, have been accumulated in past years, and these indicate a wide distribution in the State. The records are as follows:—On potato at Gatton, September, 1931, H. Hacker; on cotton at Valentine Plains, near Biloela, November, 1933, T. H. Strong; on tobacco at Mareeba, December, 1934, J. H. Smith.

The infestation during the summer of this year was evidently very widespread. Officers of the Commonwealth Prickly-pear Board bred the species from a number of sources, and A. P. Dodd, the officer in charge of the scientific work of the Board, kindly made the records available. Plants including Bathurst burr (*Xanthium spinosum*), galvanised burr (*Bassia burchii*), roly poly (*Salsola kali*), *Chenopodium cristatum*, and *Solanum* sp. were infested in the Yalleroi district of the Central-West in February; herbage was infested at Clermont and at Blythedale near Roma during the summer months, while the insect was bred from herbage at Goondiwindi in May, 1936.

A report of injury to saltbush in the Roma district during April was investigated by J. A. Weddell, who found that extensive damage was caused by caterpillars that later proved to be this species. The plants affected included the common saltbush of the district, *Atriplex muelleri*, another species of saltbush, *Atriplex* sp., *Chenopodium* sp., pigweed, Bathurst burr, and *Bassia echinopsila*. Grasses were unaffected. The caterpillars were first noticed on the saltbush about the end of January and the infestation continued during February, the following generation occurring during April. The infestation on the saltbush was of some importance as this plant represented a valuable reserve for winter feed.

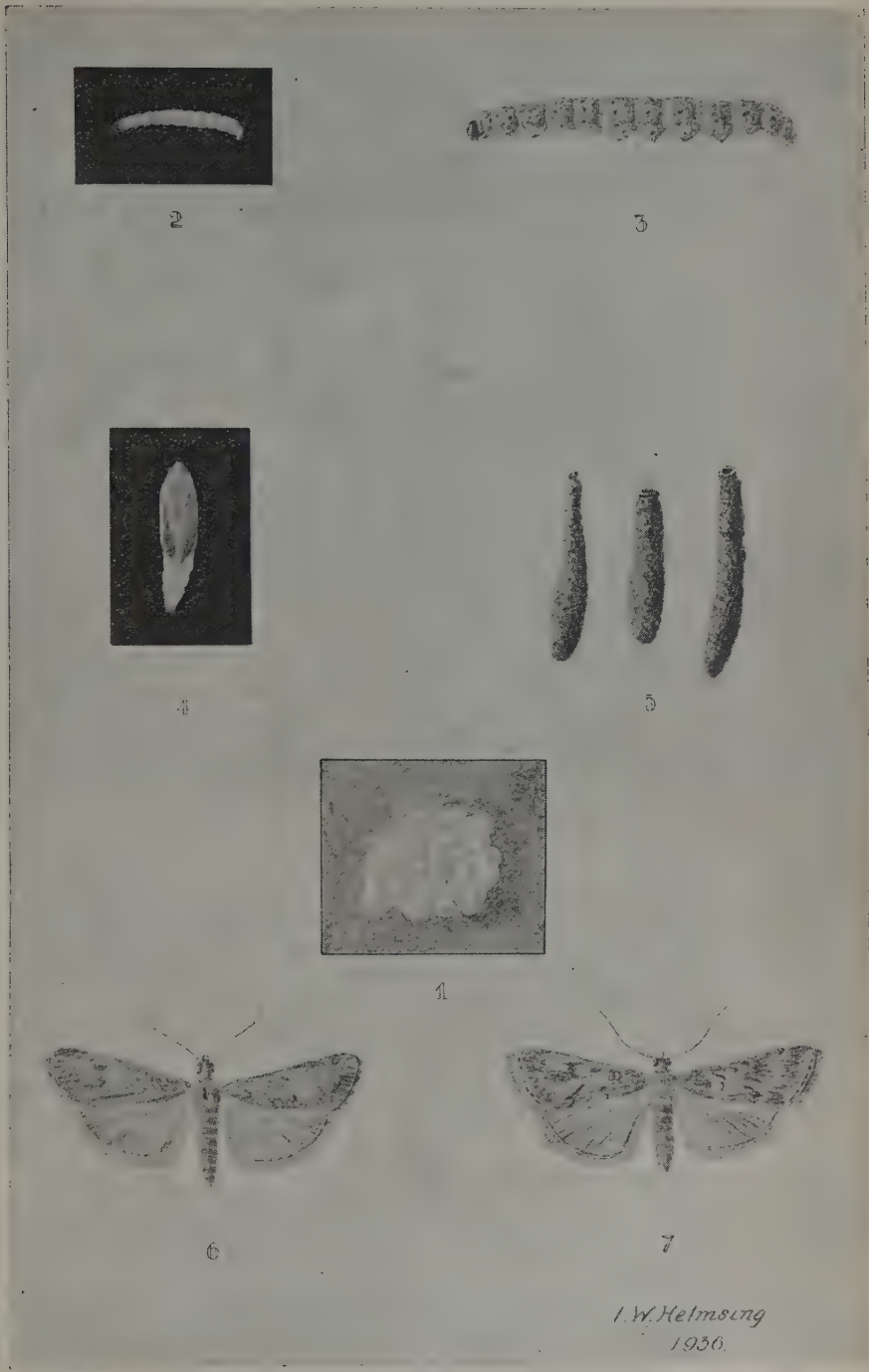


Plate 311.

Cotton Web-spinner (*Loxostege affinitalis* Led.).—Fig. 1.—Egg mass x 10. Fig. 2.—Young larva x 2. Fig. 3.—Fully-grown larva x 2. Fig. 4.—Pupa x 2. Fig. 5.—Earthen tunnels, natural size. Fig 6.—Adult male x 2. Fig. 7—Adult female x 2.

Host Plants.

Numerous weeds and crops such as cotton, maize, and lucerne were readily attacked by the pest in the outbreak in the cotton districts. Among particularly favoured weed hosts were the following:—Red pigweed (*Portulaca oleracea*), black pigweed (*Trianthema portulacastrum*), hogweed (*Trianthema decandra*), roly poly, Bathurst burr, and various species of *Amarantaceæ* and *Chenopodiaceæ*. Even hardened unattractive galvanised burr was attacked by the larvæ of the October brood.

Lucerne was the only crop on which direct laying of eggs took place, maize and cotton suffering loss from larval invasions only.

The weed host relationships were particularly interesting. With the October brood of larvæ Bathurst burr, creeping saltbush, and roly poly were specially favoured host plants, and in a number of cases in the Dawson and Callide Valleys patches of burr were completely defoliated and destroyed. With the January-February brood, despite the presence of fresh, growing Bathurst burr, not one larval specimen of the cotton web-spinner was collected from it. Roly poly was still favoured, and along with it the main weed hosts were red and black pigweeds, hogweed, and several species of *Amarantaceæ*.

The variation in host preference as between these two broods was very marked. The reason for the distinct difference in selection of weed hosts is not clear, but climatic conditions may have had some bearing on the matter. In each case the brood appeared when there was a fresh flush of weed growth following on good rains, but in the second period the amount of rain was larger, the period over which it fell was longer, and the maximum and minimum daily temperatures were considerably higher.

Probable Cause of the Outbreaks.

Following on good winter and early spring rains, there was an emergence of cotton web-spinning moths in the grasslands and old cultivation paddocks, numerous enough to annoy horses when ploughing was being done. With the plentiful fresh weed growth then present, heavy layings of eggs took place in September, and by October larvæ were very prevalent. The long dry period of November and December then intervened and few adults and no larvæ of the pest were seen again, until large numbers of moths emerged just a few days after the middle of January following on the good rains which fell from the 7th to the 14th of that month. Egg-laying again took place and large larval populations appeared.

The fourth generation of moths appeared about the middle of February and though fresh host plants were in quantity and moths laid some fertile eggs in the laboratory, no eggs were found in the field and there was no reappearance of the pest in subsequent months.

Absence of rain after the first larval brood may account for the non-appearance of the larvæ which would be expected normally in November, the duration of the life cycle from egg to pupa being approximately four weeks in summer. With the January-February brood the moths did reappear in the field in large numbers, but no further egg-laying was observed.

The outstanding climatic factors which may have had some bearing on the absence of a further observed laying of eggs in February, 1936, were—

(1) An unusually heavy fall of rain which occurred about the time of the peak emergence of the moths in mid-February; and

(2) A hot dry spell which set in immediately afterwards and was unbroken until the first week of March.

Nature and Extent of Injury.

With the weeds (Plate 314) the main injury consisted of defoliation of the plant, and where the larvæ were plentiful stems were eaten also. As mentioned previously, the October generation of larvæ was responsible for the destruction of quite an amount of Bathurst burr, but generally the attack on the weeds did not kill them. The pigweeds, hogweed, and other plants, though frequently carrying heavy populations of the larvæ, were able to seed and with the first good rains came away in a fresh mass of growth. In many cases the amount of seed actually produced was decreased, but this is not a significant factor in view of the large quantity which matures. Hence for the cotton web-spinner to be of any value in controlling these weeds, the feeding period would have to be longer or the number of broods larger and more consistently reproduced.

Eggs are laid on the tips of lucerne shoots and the young larva feeds on the tender leaves, at the same time spinning a web. By the time the larva is full grown the leaves of the lucerne shoot have become webbed together to form a tunnel within which the larva lives and eats the plant tissue. Thus the top leaves become skeletonised and bound together with a web which is cluttered with fæces. The yield of a lucerne field affected in this manner is considerably reduced, and the resulting hay is of poor quality.

Cotton and maize fields suffered from invasions of the larvæ from neighbouring breeding sources, and maize seedlings were defoliated and sometimes destroyed.

Invasions were of two types—firstly, external from weed and economic hosts, and secondly, internal from weed hosts.

The external invasions may be caused by a drying out of host plants with a consequent shortage of food such as occurred with the October brood, or abnormally heavy populations resulting in a concentration of predators and parasites causing irritation of the larvæ, or by the mechanical disturbance of the host plants.

The cotton web-spinner was associated on several occasions with the larvæ of the corn ear worm, *Heliothis obsoleta* Fabr., in both weeds and lucerne paddocks, for both favour similar hosts. Where an abnormally heavy population was the cause of migration, the corn ear worm larvæ were usually the first to migrate, but where food shortage was the trouble, both species migrated together. The corn ear worm, being a more active and more voracious feeder, was usually found in the forefront of the migration. Contamination of the host plants with web and fæces where both species were associated in heavy numbers was considered to be one of the significant stimuli in causing the corn ear worm larvæ to migrate first. The third cause of external invasions is the mechanical disturbance

of the host plants such as occurs in cutting a field of lucerne, turning in a herd of cattle to graze, ploughing a field or otherwise disturbing the larvæ, such disturbances resulting in migration.

With regard to internal invasions from weeds within the crop, this usually occurred where a farmer had allowed his cotton fields to become



Plate 312.

Cotton leaf showing characteristic damage by larvæ of the cotton web-spinner, *Loxostege affinitalis* Led. Note the webbing and entangled frass.

weedy and then cultivated while the weeds were infested with larvæ. Here again larvæ of both the cotton web-spinner and the corn ear worm were frequently found associated.

Seedling cotton (Plate 313) when invaded was often completely destroyed. In lighter infestations the young plants were defoliated, leaving the central buds more or less untouched. In such cases when fair rain fell within a reasonable period or where the soil moisture content was suitable, the damaged seedlings shot again satisfactorily.

The destruction of seedling cotton was serious because it meant that those farmers who lost cotton stands with the first attack in October were compelled to wait, in a number of instances, until after Christmas before securing sufficient soil moisture to replant. Losses with the January-February brood resulted either in the abandonment of a crop for the season or the planting of a very late crop, which all too frequently was subsequently subjected to severe attacks by other insect pests.

Older cotton, bearing squares, flowers, and bolls, when severely attacked was usually defoliated or the leaves badly skeletonised (Plate 312). Normally the bolls were unaffected, but a few squares and flowers were occasionally slightly chewed. In one instance a plot of eight-weeks-old cotton was attacked after cultivating implements had disturbed the infested weeds, and though plants were old enough to carry squares, quite a few of the attacked plants were killed.

The easily distinguishable characteristic of the attacked parts of a plant was the presence of webbing covered with excreta.

Life History.

Data gathered from the January-February outbreak of the pest indicated that a summer brood was about a month in duration from the appearance of one batch of moths to the next.

Eggs are laid in bundles of up to nine, usually on the tender tips of the host plants, and several bundles may occur on one tip. They hatch in two to four days in summer. The larval life for the same season is about three weeks.

When about to pupate the mature larva, which is active in its movements both backwards and forwards, burrows into the ground to a depth of half to one and a-half inches. In pupating it spins a web on the ground gathering pieces of debris to form a cover over the place where it enters the ground. The sides of the tunnel are lined with a tough web of silk and the tunnels may be removed intact from the soil (Plate 311; fig. 5). The larva forms a typically lepidopterous pupa at the bottom of the tunnel a few days after entering the soil. In summer the moth emerges in approximately seven days after pupation.

Description of Life Cycle Stages.

The irregularly rounded egg (Plate 311; fig 1) is small, light yellow and flat, its height being considerably less than its width. The eggs overlap each other to form a small compact bundle.

The young larva is approximately one twenty-fourth of an inch long, and is hairy with black dots situated at the hair bases. The head and the dorsum of the first thoracic segment are shiny black in colour.

The general body colour of the older larva (Plate 311; fig. 3) is light yellowish green to dark green, being of a darker shade before ecdysis, and lighter immediately after.

The head of the mature larva, which is about three-quarters of an inch long, is black. The first thoracic segment is irregularly marked with black patches, which in the young larva show up as a black plate, unbroken except for a pale-coloured median line. The segment is divided along the middle of the back by this line which is continued along the length of the larva. This is somewhat darker than the main body colour, and is bordered along either side by an irregular pale-coloured margin. A distinct creamy white irregularly shaped line runs along the entire length of the sides from the first thoracic segment.

On the thorax betwen the median and side lines are four black spots on the second and third segments. There are two black spots on the intersegmental membrane, only one being obvious in younger specimens.

On the abdomen between the median and side lines are three black spots triangularly spaced on each segment, but unless viewed by the aid of a lens these appear as one large black patch situated just above the white side line.

A black spot is found between the white line and the legs on the second and third thoracic segments, and each abdominal segment has three, except the segments bearing prolegs, in which case only two spots are present.

On the larva each of the spots forms the base of one or more hairs. Usually only one hair to each spot is found on the abdomen.

The larva is slenderly built and is typically lepidopterous, possessing a pair of legs on each thoracic segment, four pairs of abdominal legs, and a pair of claspers on the hind abdominal segment. The abdomen is composed of ten segments.

When about to pupate or after being kept in the dark, the mature larva loses colour.

The pupa (Plate 311; fig. 4) is not quite half an inch in length and is brown in colour. As a rule the wing buds appear a darker shade of brown than the rest of the pupa. The abdomen is a creamy brown, but its last segment is sometimes more intensely brown.

The moth (Plate 311; figs. 6 and 7) is not a conspicuous insect, and when at rest on the ground or in rubbish is not easily detected. The body length is approximately three-eights of an inch and the wing spread about seven-eights. The forewings of the female are brown in colour, with light and dark markings, and like the fawn-coloured hind wings carry a margin of fine hairs. The forewings of the male are fawn coloured with similarly coloured hind wings. The forewings may have dark markings. Both pair of wings carry a margin of fine hairs. The male is slightly smaller and is less stoutly built than the female.

Natural Enemies of the Cotton Web-spinner.

The larvæ were attacked by numerous predators and parasites, many of which were also active on the larvæ of the corn ear worm. Green ants were very active among the moving swarms, and Ichneumonid, Braconid, and Tachinid parasites were plentiful. In several cases observed the predatory bug, *Oechalia consocialis* Boisd., was responsible for heavy losses among the larvæ.

One or two pupæ were unearthed which were enveloped in a mass of fungus, but this type of mortality was not very common. The feeding of birds on the pests was not noticed to be very plentiful in the cotton districts despite the prevalence of the insects.



Plate 313.

Cotton seedlings with cotyledonous leaves and growing points injured by larvæ of the cotton web-spinner, *Loxostege affinitalis* Led.

Some very potent environmental control must have been at work on the adults after the last emergence in February, for although trapped moths laid fertile eggs in the laboratory, no eggs were found in the field, and not one larva was seen afterwards, despite the presence of quantities of fresh weed growth.

Control Measures.

A most important factor in the control of the pest is the maintenance of clean fields. If the various weed hosts are allowed to grow and breed larvæ, then any disturbance of the weeds may cause the larvæ to migrate to the crop. Headlands should be kept free of weeds, and crops should not be grown in close proximity to old weedy paddocks as the latter only serve as breeding sources from which the larvæ may later migrate. These two points are similarly very significant in dealing with corn ear worm, and too much emphasis cannot be placed on the need for rigid observance of these precautions. The cotton web-spinner has not been observed laying on cotton, and in all cases of damage due to its activities weed growth was primarily the important factor.

Lucerne, as previously mentioned, was the only cultivated host plant on which direct laying took place, and due to the poisoning risk to cattle it is better to refrain from using any of the poisonous insecticides on such a crop. The best way to treat an affected lucerne field is to cut it immediately the pest is detected in large numbers.

In controlling an invasion in a cotton field both the internal and external types require consideration.

With the internal type, swabbing the affected plants and nearby weeds with a solution prepared according to the formula 1 lb. arsenate of lead, 1 gallon molasses or a 7 lb. tin of treacle, and 6 gallons of water proved highly successful. The solution enables the poison to adhere to the plants, and at the same time attracts the caterpillars, although it is not considered that the power of attraction extends much more than an inch or so. It is unnecessary to cover the plants with the solution, a light sprinkle being all that is required. The solution is flipped on to the plants with a whitewash brush or a bundle of twigs or straw. About 1,000 yards of cotton two months old was done with 3 gallons of the swabbing solution. Dusting with calcium arsenate at the rate of 10 lb. per acre was only about half as effective as swabbing, the latter giving 85 per cent. control 48 hours after application. If the seedlings are less than a fortnight old replanting is usually necessary, as by the time the larvæ have eaten a lethal dose of poison, all the foliage has been destroyed. However, if only a portion of the field is affected, as is usually the case, measures as adopted for treating the external invasion should be taken to prevent larvæ migrating to clean cotton nearby.

With the external type, the well-known method of drawing a furrow and baiting with the usual cutworm bait may be used quite successfully if the migration is located before it enters the cotton, or it may be employed to prevent further spread of the pest in a field only partially invaded. The formula of the bait is as follows:—Twenty-five lb. bran, 2 quarts molasses, and 1 lb Paris green, enough water, about 2 to 2½ gallons, being added to make a friable crumbly mash. The molasses in this case is double the quantity usually recommended because of the hot dry conditions frequently prevailing when the bait is likely to be

used for the purposes under discussion. Generally this bait may be broadcast among and in front of the larvæ or spread in one or more furrows drawn directly across the advance of the invasion.

The use of freshly cut fleshy weeds which are favourite hosts of the insects, dipped in the swabbing solution previously mentioned, and strewn in a long barrier about 6 inches high in front of the advancing



Plate 314.

Typical appearance of roly poly attacked by larvæ of the cotton web-spinner, *Loxostege affinitalis* Led., showing webbing and entangled frass.

larvæ is also recommended. The fleshy weeds keep the bait fresh for a few days, and when the larvæ meet the barrier, not many of them go past it.

As a rule, however, the invasion is not noticed until it is well advanced into the cotton and is causing damage. If the seedlings are young, then replanting may be necessary, but if the bushes are four weeks or older, swabbing of the bushes gives excellent results. Twelve feet in front of the margin of the invasion should also be treated in order to catch any further migrating larvæ.

In preventing the spread of the pest in cotton carrying bolls swabbing with the poisoned molasses solution is highly recommended. It is easy to carry out, produces a high mortality among the larvæ, and has the advantage of cleaning plants when they are infested with caterpillars. In this latter respect, it is much more efficient than the ordinary bran baiting method.

The baits and the swabbing mixture must be used with discretion to ensure that domestic animals and children do not have access to them, because both the arsenate of lead and Paris green are deadly poisons.

POINTS IN HARROWING.

The entire absence of rain during the last few weeks has not been confined to one section of the State, consequently not only are the resultant dry conditions acting adversely upon the winter cereal and other crops already above ground, but are delaying the planting of sugar cane, potatoes, maize, and other staples, as well as preventing the preparation of further areas intended for summer cropping. On holdings where the latter has not already been accomplished, all energies will be concentrated on the carrying out of such work when rain comes, and care should be exercised at the same time in seeing that the loss of soil moisture, which is more or less inevitable to some extent, is reduced to a minimum. This can be accomplished economically and effectively through the use of the tine harrows, running them to and fro over the field in the same direction after the ploughing or other cultural operation has been done at the close of each day's work. On areas which have already received their final preparation, but which for some reason cannot be sown after rain, it is advisable to adopt the same procedure to restore the surface mulch and prevent the loss of moisture.

It must be realised that tine harrows will produce satisfactory results only on friable soils, so should the soil be of a clayey nature and inclined to run together, a cultivator, tined for preference, should be used for stirring the surface, for on such soils it is inimical to the best result if the mulch is made too fine.

Growing crops—such as wheat, oats, barley, and maize—derive considerable benefit through being harrowed during the early stages of their growth, but in all instances the operation should be carried out at right angles to the direction which the crop was sown—that is, across the drills. The harrow should not be allowed to collect rubbish, otherwise many of the young plants will be destroyed.

Growers should not fail to realise that maize is one of the crops on which harrowing can be practised with very beneficial results, although of necessity it can be only carried out during the heat of the day, when the plants are tough and not so likely to suffer injury.

The first harrowing may be given three or four days after sowing, and may be continued until the plants are 6 inches high, resulting in the conservation of moisture and the control of new weed growth, both between and in the rows, thereby reducing scuffling and chipping to a minimum, with a commensurate reduction in production costs.

When the all round benefits accruing from the use of the tine harrows comes to be realised, they will not continue to be the least used implements of a farmer's outfit. They are seen all too frequently propped up carelessly somewhere or lost temporarily in some corner of the cultivation. They should be the most used and highly valued implements in the farm equipment.

Studies on the Biology and Control of the Large Roundworm of Fowls, Ascaridia galli (Schrank 1788) Freeborn 1923.

F. S. H. ROBERTS, D.Sc., Animal Health Station, Yeerongpilly.

[*Continued from p.* 601, *Part V., Vol. XLVI.—November,* 1936.]

PART VI.

6. THE CONTROL OF ASCARIDIA GALLI.

1. INDIVIDUAL TREATMENT.

(iii.) Field Experiments with Carbontetrachloride.

Experiment 1.

FOR this experiment White Leghorn hens about three years old were employed. Pen 1 of 68 birds was retained as a control, and was at no time interfered with during the course of the trial; pen 3 of 66 birds was given 2 ml. carbontetrachloride following overnight starvation, on the first morning of each of the fourth, seventh, and tenth weeks; pen 2 of 68 birds was on the occasion of each treatment of pen 3 starved overnight, and next morning given 2 ml. water. In this way, it was considered, it might be possible to secure any effects of treatment associated solely with starvation and handling, and thus obtain a more accurate interpretation of any effects following the drug itself.

The egg production (E.P.) and food consumption (F.C.) per bird per week during the period of the trial are given in Table XXVII.

TABLE XXVII.

No. Pen.	No. Birds.	Treatment.	1st Week.		2nd Week.		3rd Week.		*4th Week.		5th Week.		6th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
1	68	Controls	27·0	2·1	25·5	2·3	27·8	2·5	27·0	3·2	26·6	3·5	30·3	3·7
2	68	2 ml. water	26·4	1·5	23·2	1·5	23·7	1·7	26·3	2·3	25·1	2·8	25·8	2·8
3	66	2 ml. CCl_4	28·9	1·8	25·8	1·8	25·7	1·9	26·7	2·3	26·2	2·6	26·4	2·9

No. Pen.	No. Birds.	Treatment.	*7th Week.		8th Week.		9th Week.		*10th Week.		11th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
1 ..	68	Controls	27·3	3·8	27·1	4·3	30·1	4·1	30·3	4·3	30·5	4·5
2 ..	68	2 ml. water	28·0	3·3	25·8	3·7	25·4	4·1	30·8	4·3	31·8	4·5
3 ..	66	2 ml. CCl_4	26·8	3·1	25·2	3·7	25·6	3·8	30·6	3·9	31·2	4·2

* Treated.

Effect of Treatment upon the Infestation.—During the twelfth week, that is, a little over two weeks since the last treatment, 10 birds from each pen were autopsied. A total of 33 worms was collected from pen 1, 30 from pen 2, and 3 from pen 3. These figures indicate that only a light infestation was present during the trial, and that treatment with carbontetrachloride had produced a very marked decrease in the numbers of worms.

Effect of Treatment upon Egg Production.—A consideration of the actual figures of production per bird per week as presented in Graph No. 8 shows firstly that the production of the control birds was highest throughout the whole period of the trial. The production of the birds, which were starved, handled, and given water (pen 2) was at the beginning of the trial lower than that of either the controls or of the

birds given carbontetrachloride, but gradually increased, however, and at the end of the eighth week overtook that of the controls. The production of the birds to which 2 ml. carbontetrachloride (pen 3) had been given, however, never at any time equalled the controls, and at the end of the fourth week was overtaken by that of the birds given water only, whose production, thereafter, in general remained the greater. There is no consistent evidence, however, that the production of Pen 3 during the week in which treatment was applied decreased very markedly. Any immediate effects of treatment on egg production would seem to have been slight, but as a result, the treated birds over the period of the trial did not at any time reach full production.

GRAPH No. 8.

INDIVIDUAL TREATMENT WITH CARBONTETRACHLORIDE. EXPERIMENT 1.

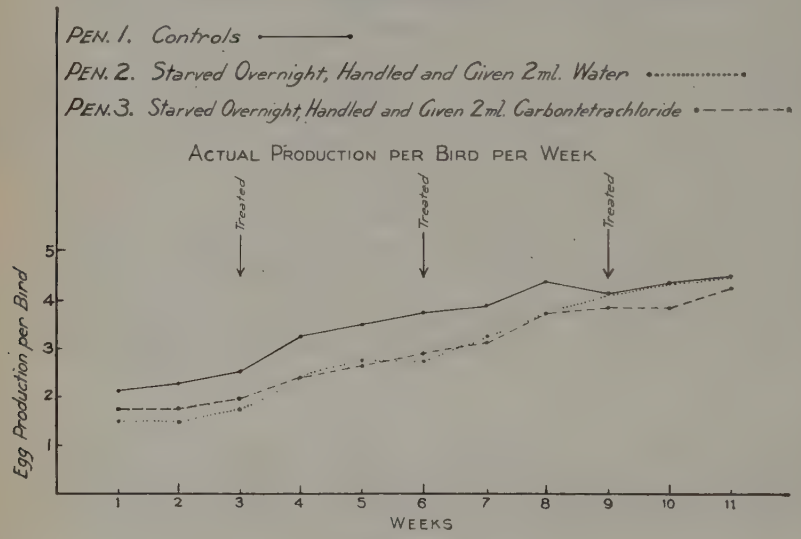


Plate 315.

When the figures of production for the three pens were corrected it was found that, over the eight weeks' period in which treatment was applied, the control pen had produced 56·0 eggs per bird, the pen given water 60.9 eggs per bird, and the pen given carbontetrachloride 52.9 eggs per bird (standard error 1.2). While there is a significant difference between the production of the control pen and of the pen given water, this cannot be regarded as indicating that starvation, handling, and the administration of 2 ml. water are beneficial to production, but it at least denotes that in this case starvation and handling did not decrease production. The difference between the production of the controls and of the birds given carbontetrachloride, whilst not significant, is very nearly so, while the difference between the production of the treated birds and of the birds given water only is highly significant, indicating that under the conditions of the experiment, treatment with 2 ml. carbontetrachloride did have an adverse effect upon production.

Effect of Treatment upon Food Consumption.—Corrected food consumption figures over the eight weeks treatment was applied showed that pen 1 consumed 445·1 oz. per bird, pen 2 463·6 oz. per bird, and pen 3 426·0 oz. per bird (standard error 5·49). The consumptions of

pens 1 and 2 were therefore significantly higher than that of pen 3, which had been treated with carbontetrachloride. There were, however, no significant differences between the consumption of any of the pens in so far as the ratio, food consumed per bird—per dozen eggs produced was concerned, as for every dozen eggs produced, pen 1 consumed 194.13 oz., pen 2, 194·58 oz., and pen 3, 204·36 oz. (standard error 5·34).

Toxicity.—No marked and lasting ill-effects of treatment with 2 ml. carbontetrachloride given per syringe were observed at any time in any of the 66 birds to which this dose was administered. On the occasion of each treatment a few birds appeared temporarily depressed, but recovered very rapidly. The day immediately after treatment was occasionally characterised by a conspicuous decrease in production, but this effect was not consistent.

Experiment 2.

The birds used for this trial were Australorp hens about three years old. Pen 4 of 30 birds was retained as untreated controls. Pen 5 of 31 birds was given 2 ml. carbontetrachloride following starvation overnight, on the first day of the sixth, ninth, and twelfth weeks.

Food consumption (F.C.) and egg production (E.P.) per bird per week during the period of the trial are given in Table XXVIII.

TABLE XXVIII.

No. Pen.	No. Birds.	Treatment.	1st Week.		2nd Week.		3rd Week.		4th Week.	
			F.C.	E.P.	F C.	E.P.	F.C.	E.P.	F.C.	E.P.
4 ..	30	Control	..	2·8	..	2·8	32·0	3·2	28·2	2·9
5 ..	31	2 ml. carbontetrachloride ..	..	1·6	..	1·7	31·0	2·2	28·7	2·6

No. Pen.	No. Birds.	Treatment.	5th Week.		*6th Week.		7th Week.		8th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
4 ..	30	Control	30·6	3·0	32·9	2·9	30·3	3·4	33·0	3·5
5 ..	31	2 ml. carbontetrachloride	29·9	2·8	33·6	2·7	29·9	3·0	27·7	3·3

No. Pen.	No. Birds.	Treatment.	*9th Week.		10th Week.		11th Week.		*12th Week.		13th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
4 ..	30	Control	27·0	3·2	31·0	3·6	33·7	3·6	34·0	3·9	33·5	4·0
5 ..	31	2 ml. carbontetrachloride	34·8	2·7	31·2	3·5	29·4	3·4	30·3	3·9	35·4	4·1

* Treatment.

Effect of Treatment upon the Infestation.—This was not determined, as no birds were available for autopsy.

Effect of Treatment upon Production.—The actual weekly production per bird in the treated and control pens over the period of the trial is presented in Graph No. 9. From this graph it will be observed that over the five weeks prior to treatment the production of pen 5 showed a marked and steady increase, and it would appear that the effect of the first treatment was such as to arrest this increase, and that thereafter the subsequent treatments did not permit the production to equal that of the controls till the twelfth week. There is no consistent evidence, however, that production was decreased during the week of treatment such as one might expect to follow from the administration of the drug. There was certainly a decrease following the first and second treatments, but

in these instances a decrease also occurred in the production of the controls, whereas the third treatment was associated with an immediate increase. The corrected figures of total egg production over the period in which treatment was applied, however, showed that the controls produced 24·9 eggs per bird, and the treated pen 29·8 eggs per bird (standard error 1·25). The difference of 4·9 eggs per bird is significant and indicates that treatment was beneficial to this extent.

GRAPH No. 9.

INDIVIDUAL TREATMENT WITH CARBONTETRACHLORIDE. EXPERIMENT 2.

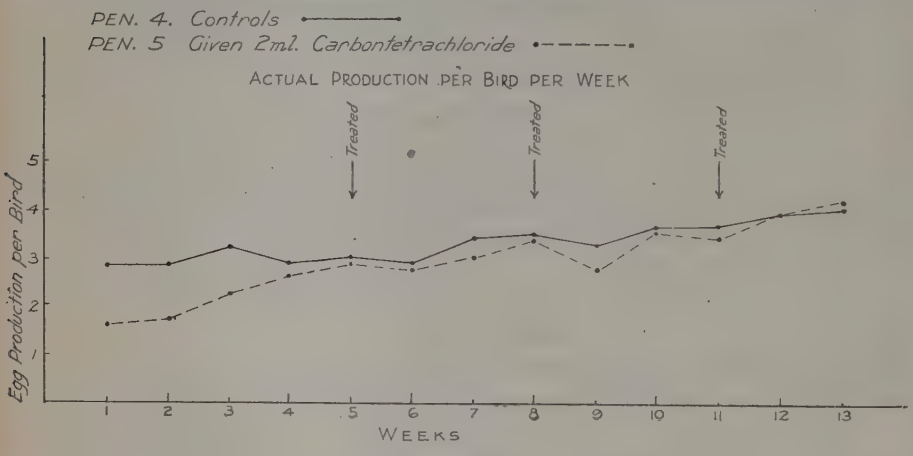


Plate 316.

Effect of Treatment upon Food Consumption.—There was no difference between the food consumption of both pens over the period treatment was undertaken, as each pen consumed 253·8 oz. per bird (corrected figures), but when the amounts of food consumed per bird by each pen to produce a dozen eggs were compared it was found that pen 4 required 123·39 oz., and pen 5 104·13 oz. (standard error 5.97), thus indicating that as a result of treatment the birds consumed significantly less food per egg produced than the untreated birds.

Discussion.

As only a light infestation existed in Experiment 1, and as no evidence was secured of the presence of worms in Experiment 2, the results regarding the effect of treatment upon egg production, etc., as indicated from these two trials, may quite conceivably have a different interpretation when heavily-infested birds are treated. Furthermore, treatment was given at three-weekly intervals and such effects as were instanced here may not be repeated with treatments more widely spaced. The three-weekly interval was selected in view of the recordings in the literature of the harmful effects of treatment upon production, as it was considered that with such frequent treatments any such ill-effects would be exaggerated and thus readily observed.

Where preventive measures are not enforced, the ideal interval between treatments to secure efficient control would be such that the worms would not become sufficiently large or numerous to affect the health of the fowl in any way. Such an interval would also take into

account the maturity period of the worms in grown birds, which is at present unknown. Further experiments in the use of carbontetrachloride in the field are, therefore, desirable, in which heavily-infested birds are employed, and in which the interval between treatments is longer than three weeks.

The interpretations of the results secured from the two experiments described above may be summarised as follows:—

1. Treatment with 2 ml. carbontetrachloride proved very effective against *A. galli*.

2. The starvation and handling accompanying treatment did not in this instance affect the production of White Leghorn hens. This effect was not expected as this breed is generally regarded as being notoriously "temperamental," as a consequence of which production may be affected by unusual circumstances. That no such effects were observed in this case may have been due to the fact that the birds had just recovered from a moult. It is also frequently asserted that during the spring months White Leghorns may be handled with impunity. Further investigation into this point is required with treatments given at various times throughout the year.

3. Over the period of the trial in which treatment was applied, a pen of treated Australorps yielded significantly more eggs than an untreated pen though full production was not reached till the twelfth week of the trial. On the other hand, the production of a pen of treated White Leghorns was less than that of a control, untreated pen, and much less than that of a pen given identical treatment, but with the carbontetrachloride replaced by water. In either experiment there was no marked and consistent decrease in production accompanying treatment as is recorded in the relevant literature, but in the case of the White Leghorns the weekly increase in production was in general smaller than that of the controls, so that at no time did the birds reach full production.

Thus treatment was not very harmful to the production of the Australorps, but was apparently detrimental to that of the White Leghorns. This may have been associated simply yith the physiology of the breeds or it may indicate that the 2 ml. dose of carbontetrachloride as given at three weekly intervals was more readily tolerated by the heavier Australorps.

4. The fact that over the period of the trial the treated White Leghorn pen consumed significantly less food than either the control pen or the pen given water, but that the food consumed per egg produced ratio remained without any significant differences between the three pens, also indicates an intolerance by the treated pen to the treatment employed. The treated and control Australorps, however, consumed practically the same amount of food, but in this case the treated pen consumed a significantly smaller quantity of food for every egg produced than the untreated pen.

2. FLOCK TREATMENT.

(i.) Resume of Previous Investigations.

In 1916 Herms and Beach[65] evolved a flock treatment for the removal of roundworms from poultry which they claimed to be highly efficacious. They recommended that the birds to be treated should be fed one-half the usual evening ration on the day previous to treatment.

They were then to be starved till 2 p.m. the next day, and then given one-half the usual ration to which was added 1 lb. of finely-chopped tobacco stems previously steeped for two hours in sufficient water to cover them, both the chopped-up stems and the liquid being used. This quantity was sufficient for 100 birds. Two hours later the birds were to be given one-fourth the usual ration in which Epsom salts at the rate of 11 oz. for every 100 birds was mixed. The treatment was to be repeated after seven days, and during the feeding of the treated mash care was to be taken that every bird secured its share.

This infusion was tested by Hall and Foster[60] on six chickens. The birds refused to eat all the prepared mash on the first day, and were fed the remainder on the second day. The infusion was mixed with bran, but the birds were at no time eager for it. Unfortunately, no Ascaridia were present in any of the birds treated, but as 30 out of 162 *Heterakis gallinæ* were passed, Hall and Foster were of the opinion that the infusion would also show a degree of efficiency against the large roundworm.

The writer[87] gave this tobacco infusion to 12 birds not exposed to reinfestation, repeating the treatment after ten days, but the number of Ascaridia passed was computed to be only 47 per cent of the total number present.

According to Freeborn[53] the use of commercial tobacco dust as a flock treatment was first introduced by a Californian poultry farmer. It was tested by Dougherty and Beach[48], and satisfactory results were secured from the feeding of a dry mash containing 2 per cent tobacco dust for a period of three weeks. Freeborn[51, 52, 53] reporting on trials carried out by him found that if a dry mash containing 2 per cent. tobacco dust with a 1·5 per cent. to 2 per cent. nicotine content was fed for a period of one month it was 90 per cent. to 100 per cent. effective against *A. galli,* and 80 per cent. to 85 per cent. effective against *H. gallinæ*. He also noted that although treated birds consumed less food than untreated birds, they transformed 9.52 per cent of the food into body weight, whereas untreated birds transformed only 9·33 per cent.

A report by the Missouri Poultry Station[85] indicated that satisfactory results may be obtained from the use of tobacco dust with a nicotine content of only 1 per cent. Hebrant and Liegeois[66] and Kaupp and Dearstyne[71] have also reported favourably on this method of flock treatment. The writer[87] tried a dry mash containing 2 per cent. tobacco dust on 12 birds over a period of three weeks, but only 34 per cent. of the Ascaridia present were estimated to have been removed. The nicotine content of the tobacco dust employed, however, was only ·86 per cent.

Despite very satisfactory laboratory trials, Freeborn[52, 53] found that this method of flock treatment was not always successful when applied in the field. These unfavourable results he considered were due chiefly to the fact that commercial tobacco dust may contain too small a percentage of nicotine or that the prepared mash may be distasteful to some of the birds. He, therefore, endeavoured to use nicotine sulphate as a flock treatment, but his experiments with this drug either in the drinking water or mash showed that when nicotine sulphate was given in sufficient quantities to remove the worms it was both distasteful and toxic. Nicotine sulphate as a flock treatment was also tested by Old and Knox[78]. They found that the highest limits of dilution that could be given in drinking water without toxic effects was 9 ml. in 991 ml. of water.

When mixed with the mash it was possible to increase the amount of the drug to 10 ml. in 990 ml. of water.

Another drug recommended for mixing with the mash as a flock treatment is oil of chenopodium. According to the Californian Experiment Station good results may be secured by mixing this drug with a small quantity of mash at the rate of 1 teaspoonful for every 12 birds. The writer used the mixture on twelve birds[87] and obtained an estimated efficiency of 42 per cent.

(ii.) Laboratory Experiments.

THE ADMINISTRATION OF DRUGS IN DRINKING WATER.

It was felt that as the intake of drinking water varies to a great extent throughout the year and does not, moreover, appear to be associated with age or weight to the same degree as the intake of food, consistent results from any drug administered in this way could not be expected.

The use of a 1-3,000 carbontetrachloride emulsion (Finnemore[49]) for fourteen days, and of 1-5,000 dilutions of copper sulphate and nicotine sulphate respectively for eight days did not give any promising degree of efficiency. A 1-1,500 dilution of nicotine sulphate, however, gave better results. Over a three days period, 10 birds, 24 oz.-37 oz. in weight, given this dilution, passed 19 worms with 75 remaining on autopsy. The trial was not continued longer than three days as a comparison of the water consumption of the treated birds, namely 150 ml. per bird per day, with that of the controls, namely 230 ml. per bird per day*, indicated that the dilution was distasteful.

THE ADMINISTRATION OF DRUGS IN THE MASH.

Carbontetrachloride.

This drug, administered in a small quantity of mash with equal parts of liquid paraffin or in the form of an emulsion (Finnemore[49]), did not give any efficiency for the quantities employed, which were such that each bird would consume 1 ml. of the drug.

Tobacco Dust.

A preliminary test by the writer[87] with a dry mash containing 2 per cent. tobacco dust (·86 per cent. nicotine) fed over a period of three weeks did not give very promising results, due probably to the low nicotine content of the tobacco dust employed. Enquiries have since shown that a commercial tobacco dust containing more than about 1 per cent nicotine is not obtainable in Queensland. An experiment was, therefore, carried out, using 11 birds which were fed 4 per cent. tobacco dust (·81 per cent nicotine) in the mash, thus approaching the amount of nicotine in the treated mash recommended by Freeborn. This mixture proved decidedly distasteful, as at the end of seven days, when the experiment was discontinued, the treated birds had consumed only 1·6 oz. per day per bird as compared with 2·6 oz. per day per bird by the controls.

**Note.*—Evaporation, which was the same for both groups, is included in these figures of water consumption.

Nicotine Sulphate (40 per cent. nicotine) and Copper Sulphate.

In the first trial with these two drugs, 10 birds, 22 oz. to 33 oz. in weight, were fed a mash containing ·5 ml. nicotine sulphate* and ·5 gm. copper sulphate in 100 ml. of water per pound. This treated mash was kept constantly before the birds, but was always freshly mixed each day. After a four-day period 64 worms had been passed, the majority of which, namely 42, were voided on the third day. During this period the food consumption of 10 control birds, of similar weights, on untreated mash was 2·7 oz. per day per bird, and that of the treated birds 2·8 oz. per day per bird. On autopsy 40 worms were present, the efficiency of this treatment over the four-day period being, therefore, 61·5 per cent.

In a second experiment a mash containing ·5 ml. nicotine sulphate and 1 gm. copper sulphate in 100 ml. water per pound was employed with 11 birds averaging 27 oz. in weight. At the end of two days feeding 74 worms had been passed. As the food consumption of the treated birds during this period was only 1·9 oz. per day per bird, as compared with 2·8 oz. per day per bird by the controls, and as the droppings of the treated birds had become noticeably hard and scanty in character, the trial was discontinued. On autopsy 71 worms remained, giving an efficiency of 51 per cent. for this mixture with two days' feeding.

Nicotine Sulphate (40 per cent. nicotine).

In these trials a mash containing nicotine sulphate at the rate of ·5 ml. in 150 ml. of water per pound of dry mash was employed. As in the above experiments the treated mash was kept constantly before the birds, and was freshly mixed every day.

(*a*) In the first trial 11 young White Leghorn cockerels, 17 oz. to 26 oz. in weight were used, and the treated mash was fed over a period of eight days. During this period a total of 120 worms were eliminated. As no worms were voided on the ninth day the birds were autopsied, and it was found that 57 worms had survived—an efficiency of 67.8 per cent.

The food consumption of the treated birds over this period was 2.7 oz. per day per bird, and the average gain in weight 5·5 oz. Eleven control birds, 16 oz. to 26 oz. in weight, consumed 2·7 oz. of mash per day per bird and gained in weight 4·5 oz. per bird.

(*b*) In a second experiment, 119 worms were removed from 12 young birds, 19 oz. to 26 oz. in weight over a seven-day period. On autopsy, 43 worms were present, an efficiency of 71·2 per cent.

The food consumption of the treated birds was the same as that of the controls, namely 2·7 oz. per day per bird, and the gain in weight an average of 4·2 oz., as compared with 4·3 oz. by the controls.

(*c*) In this trial seven White Leghorn cocks, 3 lb 5 oz. to 4 lb. 3 oz. in weight, and one pullet, 2 lb. 2 oz. in weight, were given this prepared mash. After seven days 151 worms had been passed, and as no worms had been voided since the fifth day, the experiment was discontinued. The food intake was equivalent to 3·4 oz. per day per bird, and on autopsy six worms, none larger than 20 mm. in length, were found to be present. This gives an efficiency for the five-day period of treatment of 96·2 per cent.

*Note.—This amount of nicotine sulphate was computed from an estimation of the amount of nicotine consumed per day by birds if given a mash containing 2 per cent. tobacco dust with a 2 per cent. nicotine content.

(*d*) In a further experiment with grown birds five Australorp cocks, 4 lb. 1 oz. to 5 lb. 15 oz., were employed. After five days 42 Ascaridia had been voided. The food consumption was 3·9 oz. per day per bird over the seven days of treatment, and on autopsy 10 very small worms 4 mm. to 15 mm. in length were found to have survived—an efficiency of 80.8 per cent.

(*e*) In a final test with 10 adult hens, 3 lb. 10 oz. to 4lb. 11 oz. in weight, the prepared mash fed for a period of seven days removed 109 worms, and gave an efficiency of 100 per cent. The food consumption varied from 3.3 oz. to 3.5 oz. per day per bird.

Discussion.

The results secured show that a mash containing ·5 ml. of nicotine sulphate per pound weight of dry mash is capable of giving a high efficiency against *A. galli* if fed continuously over a period of 7-8 days. From a total of 45 birds, 23 young birds and 22 adult birds, to which this prepared mash was offered for this period, 541 worms were removed, leaving 116 on autopsy, an efficiency of 82·5 per cent.

The trial with a mash to which ·5 gm. of copper sulphate per pound was added in addition to the nicotine sulphate indicates that good results may be also secured from this combination. A comparison of the efficiencies computed from a four days' feeding of a mash containing nicotine sulphate alone does not, however, indicate that the addition of the copper sulphate is warranted. The trial in which 1 gm. of copper sulphate per pound of mash was employed with the nicotine sulphate also denotes that copper sulphate fed continuously over a few days may have harmful effects upon the birds so treated.

In the case of the young birds given this nicotine sulphate mash, the food consumption and gains in weight of the treated birds compared very favourably with the food consumption and gains in weight by the control birds. No suitable controls could be maintained for the adult birds, but a comparison of their food consumption, 3·3 oz. to 3.9 oz. per day per bird, with that of similar birds reared on the intensive system on this station, namely 3·4 oz. to 4 oz. per day per bird, indicates that the prepared mash was not distasteful in any way.

It is interesting to observe the rate at which the worms were voided by the birds of different ages employed in these trials, as given in Table XXIX.

TABLE XXIX.

No. of Group.	No. of Birds.	Age.	Worms Voided.									
			1st Day.	2nd Day.	3rd. Day.	4th Day.	5th Day.	6th Day.	7th Day.	8th Day.	Total.	Per cent. Efficiency.
51 ..	11	3 months ..	26	36	28	14	7	9		1	120	68·7
52 ..	12	3 months ..	16	42	27	29		4	1	..	119	71·2
53 ..	12	9 months ..	95	76	21		..	..	1	..	193	92·3
54 ..	10	Aged ..	19	79	9		1	1	..	..	109	100·0

It would appear from this table that the worms were more readily and more rapidly removed from the older birds by this nicotine sulphate mash. In the older groups, the efficiencies were considerably higher and

were for the most part obtained, moreover, after only four days' feeding, whereas in the young birds, a good number of worms were still present after seven days' treatment.

Another observation of significance is that, in the old birds given this prepared mash, the infestation that survived treatment consisted entirely of young, immature worms (Group 53).

In conclusion, it may be said that the above experiments indicate that the feeding of a dry mash to which is added ·5 ml. of nicotine sulphate per pound for a continuous period of seven days is efficient against *Ascaridia galli* and harmless to the birds. The mash was prepared freshly every day, and it was found the nicotine sulphate was best mixed when each ·5 ml. was added to 150 ml. of water. The mixing was thorough, so that the mash remained flaky and devoid of lumps.

Efficiency against Heterakis gallinae.

As groups 53 and 54 also contained a natural infestation of the cæcum worm, *Heterakis gallinæ,* the opportunity was taken to ascertain the efficiency of this prepared mash against this species after a period of feeding for seven days. A total of 856 worms were passed by the 22 birds treated, and on autopsy 713 remained. These figures indicate an efficiency of 54·5 per cent.

(iii.) Field Experiments, With Nicotine Sulphate.

Experiment 3.

The birds employed in this experiment (White Leghorns) had been received as day old chicks. At one month old they were divided at random into two groups, each of which was confined to a separate pen. One group (A) was infested with *A. galli,* and the second group (B) was maintained under conditions most likely to keep them worm free. At this time, the writer had in mind an experiment in which the production of wormy and clean birds could be compared so that any effects of *A. galli* upon production could be noted. After some time, however, Group (B) became infested, and this experiment had to be abandoned. Four months before these treatment trials commenced Group (A) was divided between two pens, Nos. 8 and 9, and Group (B) between two pens, Nos. 6 and 7. The infestations existing at any subsequent time in pens 6 and 7 and in pens 8 and 9 respectively should therefore have been approximately equal. When the trial was commenced pen 6 was retained as a control to pen 7, and pen 8 as a control to pen 9. Pens 7 and 9 were given a nicotine sulphate prepared mash (·5 ml. nicotine sulphate in 150 ml. water per pound of mash), for a period of seven days during the sixth, tenth, fourteenth, and eighteenth weeks of the trial. During the periods when these two pens were treated, the control pens were given a mash containing 150 ml. water per pound of dry mash. These birds were about eight months old when the trial was commenced.

The food consumption (F.C.) and egg production (E.P.) per bird per week of the four pens over the period of the trial are given in Table XXX.

TABLE XXX.

No. Pen.	No. Birds.	Treatment.	1st Week.		2nd Week.		3rd Week.		4th Week.		5th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
6 ..	25	Control	24·5	3·0	24·5	3·2	24·5	3·9	24·5	3·6	24·5	4·2
7 ..	24	Ni. Sulph.	24·5	2·9	24·5	3·0	24·5	4·0	24·5	3·1	24·5	4·0
8 ..	23	Control	23·6	3·9	23·6	4·0	23·6	4·1	23·6	4·6	23·6	5·0
9 ..	26	Ni. Sulph.	22·2	3·0	22·2	3·1	22·2	3·6	22·2	3·7	22·2	4·4

No. Pen	No. Birds.	Treatment.	*6th Week.		7th Week.		8th Week.		9th Week.		*10th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
6 ..	25	Control	27·4	4·4	28·0	5·0	30·7	5·1	30·2	4·7	32·8	4·5
7 ..	24	Ni. Sulph.	27·0	4·0	25·3	3·5	30·3	3·7	30·2	4·6	24·1	4·5
8 ..	23	Control	29·4	4·5	24·0	4·8	30·2	4·7	31·1	4·9	26·6	4·1
9 ..	26	Ni. Sulph.	30·8	4·6	23·1	4·5	31·2	4·5	29·7	4·9	29·6	4·7

No. Pen.	No. Birds.	Treatment.	11th Week.		12th Week.		13th Week.		*14th Week.		15th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
6 ..	25	Control	29·0	4·4	32·6	4·8	30·3	5·2	32·1	5·1	31·0	5·0
7 ..	24	Ni. Sulph.	27·5	2·7	29·9	3·3	27·6	4·4	26·1	5·2	31·0	4·7
8 ..	23	Control	24·8	3·1	28·8	3·3	22·5	3·9	31·0	3·9	31·5	4·2
9 ..	26	Ni. Sulph.	28·0	4·5	28·9	4·4	27·3	4·5	26·5	4·0	30·8	4·0

No. Pen.	No. Birds.	Treatment.	16th Week.		17th Week.		*18th Week.		19th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
6 ..	25	Control	30·4	4·3	30·8	4·5	36·0	4·3	31·5	4·3
7 ..	24	Ni. Sulph.	28·3	4·7	32·2	5·0	30·4	5·3	36·5	5·2
8 ..	23	Control	34·0	4·3	31·0	4·5	35·3	4·6	32·5	5·1
9 ..	26	Ni. Sulph.	26·7	4·1	29·5	4·3	29·7	4·3	28·8	4·2

* Week of treatment.

Effect of Treatment upon the Infestation.—During the week of the first treatment (sixth week) large numbers of worms were passed by pens 7 and 9. To check this observation, five birds from each pen were autopsied at the beginning of the seventh week. From pen 6 an average of 34·2 worms were secured, the majority of which (126) came from one bird. Pen 7 yielded only 2·0 worms per bird; pen 8, 32·2 worms per bird, the infestation in this case being fairly evenly distributed among the five birds examined, and pen 9, 1·4 worms per bird. The worms remaining in the treated birds were all small in size, moreover, whilst those from the controls contained a good number of large and mature forms.

At the conclusion of the trial and during the twentieth week 17 birds from each of the pens 6, 8, and 9, and 16 birds from pen 7 were examined. The number of worms collected from each of the respective pens is given in Table XXXI.

TABLE XXXI.

Number of Pen.	Number of birds examined.	Total number of worms present.	Range of Infestation.	Average number worms per bird.
6 (control)	17	337	0–126	19·8
7 (treated)	16	109	0–37	6·8
8 (control)	17	869	2–135	51·1
9 (treated)	17	73	0–11	4·3

Here again the worms remaining in the treated birds were all small in size (mainly about 1 inch in length), whilst of those from the controls a good percentage were large and mature.

Taking into consideration the fact that the worms that survived treatment were all small and immature forms, these results indicate that the nicotine sulphate treatment had been successful in controlling the infestations under conditions involving a continuous exposure of the birds to infection. Such control is especially prominent in the the case of pens 8 and 9, where a very heavy infestation was undoubtedly present.

As all pens had picked up a natural infestation of *Heterakis gallinæ* before the subdivision of the two groups, the opportunity was taken to ascertain whether the efficiency of this treatment as secured under laboratory conditions would be confirmed. The results obtained are given in Table XXXII.

TABLE XXXII.

Number of Pen.	After First Treatment.		At End of Trial.	
	Number of birds examined.	Number *H. gallinæ* per bird.	Number of birds examined.	Number *H. gallinæ* per bird
6 (control)	5	4·8	17	16·7
7 (treated)	5	2·0	16	7·5
8 (control)	5	5·6	17	40·1
9 (treated)	5	1·4	17	22·8

These figures indicate, it is considered, that this nicotine sulphate treatment continued over a period of seven days may under field conditions assist in controlling *Heterakis gallinæ*.

Effect of Treatment upon Egg Production.—The actual weekly production per bird of the four pens employed in this experiment is presented in Graph No. 10. A consideration of the production of pens 6 and 7 (Graph No. 10 (A)) shows that a decrease in production occurred during the period following each treatment, the production thereafter increasing gradually till the next treatment was given. The fall in production after the second treatment is very marked, and out of all proportion to the decreases that occurred after the other treatments, and was probably assisted by other influences. On the whole, however, the production of pen 7 shows a gradual rise, and after the third treatment overtook that of the control pen, and thereafter remained the greater. A comparison of the figures of corrected egg production for the fourteen weeks in which treatment was applied, namely, 67·0 eggs per bird from pen 6, and 65·0 eggs per bird from pen 7 (standard error 2·555), did not disclose any significant difference between the production of the two pens. It would appear that if the decrease in the production of pen 7 following the second treatment had been of somewhat similar value to the decreases that occurred after the other treatments, the treated pen would have produced significantly more eggs than the control pen.

Pen 6, it will be remembered, at the conclusion of the trial showed, on the average, only a light infestation, namely 19·8 worms per bird, but from a consideration of Graph No. 10 (A), however, it would appear as though this infestation had been responsible for the decrease in production which occurred during the last four weeks of the trial. Although the average number of worms per bird was comparatively small, the individual infestations showed a very marked variation in numbers, and it is considered that this drop in production was chiefly due to the very heavy infestations that were present in some of the birds.

When the production of pens 8 and 9 is considered (Graph No. 10 (B)) it will be seen firstly that the production of the control pen (pen

GRAPH No. 10.

FLOCK TREATMENT WITH NICOTINE SULPHATE. EXPERIMENT 3.

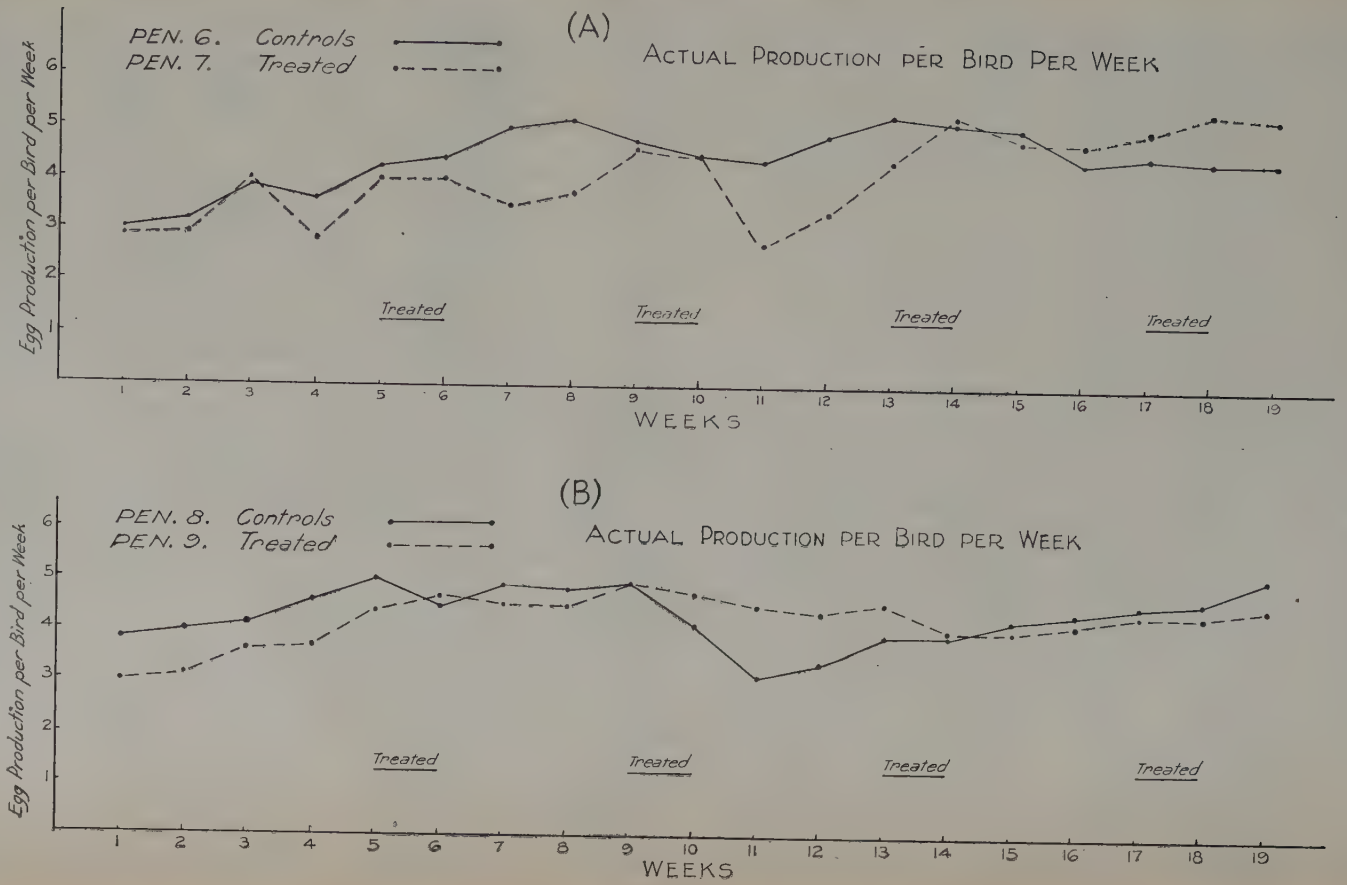


Plate 317.

8) showed considerable fluctuation. After the ninth week a very marked drop in production occurred, and the production of the previous few weeks was not reached again till the final period of the trial. In the case of the treated pen (pen 9), although a decrease in production was associated with treatment, such decreases were not so marked or consistent as they were in the other treated pen (pen 7). Over the final five weeks of the experiment the control birds were producing the greater number of eggs, despite the apparently heavy infestation present (see Table XXXI.). This may be explained as being possibly associated with the fact that in birds exposed to heavy infestation, there are, as denoted by the fluctuations in the production of pen 8, periods in which the infestation is largely eliminated, and during which the production increases. Then follows rapid reinfestation, and production is again effected. For example, in pen 8, the birds were apparently very heavily infested during the tenth and eleventh weeks. Following the spontaneous loss of many worms the production gradually increased. The autopsies during the twentieth week, whilst showing a heavy infestation, averaging 51·1 worms per bird, in the birds of this pen, also denoted that a large percentage of these worms were small, so that although the infestations were numerically heavy, the worms were not in general large enough to be pathogenic so far as could be determined from production. It is, therefore, considered that had the experiment been continued over a longer period a further marked decrease in the production of pen 8 would have occurred. This opinion is strengthened by the frequency with which a condition of enteritis was observed, though as yet not very advanced, in these birds at the autopsies.

From corrected figures it was found that over the fourteen weeks in which treatment had been applied pen 8 had produced 51·5 eggs per bird and pen 9 64·3 eggs per bird (standard error 2·555). Treatment therefore, was responsible for a significantly greater production over this period to the extent of 12·8 eggs per bird.

Effect of Treatment upon Food Consumption.—Corrected figures of total food consumption over the fourteen weeks during which treatment was applied gave a consumption of 421.6 oz. per bird for pen 6, 395·2 oz. per bird for pen 7, 421·6 oz. per bird for pen 8, and 414·1 oz. per bird for pen 9 respectively (standard error 8·35). In both cases the consumption of the treated pens was below that of the controls, but only the difference between pen 6 and pen 7 is significant.

Although no analysis was possible of any correlation between food consumption—treatment—body weight, as individual weights were not taken, it is interesting to compare the average gain in weight per bird from weighings taken thirteen weeks before the first application of the treatment, and again at the termination of the trial. During this twenty-seven weeks' period pen 6 showed an average gain in weight per bird of 25·9 oz.; pen 7, 26·2 oz.; pen 8, 20·2 oz.; and pen 9, 27·7 oz. This would indicate, especially in the case of pens 8 and 9, that the food consumed-increase in body weight ratio was less in the untreated pens, showing, therefore, that the infestations had been responsible for this effect.

As regards the ratio, food consumed per bird per dozen eggs produced, corrected figures showed that pen 6 consumed 75·9 oz. per bird; pen 7, 74·82 oz. per bird; pen 8, 103·32 oz. per bird; and pen 9, 77·16 oz. per bird respectively (standard error 2·12). Thus, the effect of treatment on pen 9 had been to give a significantly smaller consumption for

every dozen eggs produced to the extent of 25·16 oz. The consumptions of pens 6 and 7, however, were practically equivalent.

Experiment 4.

For this experiment Australorp hens three years of age were available. The procedure of treatment was similar to that used in Experiment 3, but in this case the nicotine sulphate prepared mash was fed on three occasions at three-weekly intervals, during the sixth, ninth, and twelfth weeks.

Egg production (E.P.) and food consumption (F.C.) per bird per week throughout the period of the trial are given in Table XXXIII.

TABLE XXXIII.

No. Pen.	No. Birds.	Treatment.	1st Week.		2nd Week.		3rd Week.		4th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
10 ..	31	Ni. Sulph.	..	1·5	..	1·9	31·0	2·0	27·0	2·5
4 ..	30	Control	..	2·8	..	2·8	32·0	3·2	28·2	2·9

No. Pen.	No. Birds.	Treatment.	5th Week.		*6th Week.		7th Week.		8th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
10 ..	31	Ni. Sulph.	28·5	2·4	27·3	3·1	27·3	3·3	24·0	3·2
4 ..	30	Control	30·6	3·0	32·9	2·9	30·3	3·4	33·0	3·5

No. Pen.	No. Birds.	Treatment.	*9th Week.		10th Week.		11th Week.		*12th Week.		13th Week.	
			F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.	F.C.	E.P.
10 ..	31	Ni. Sulph.	27·6	3·1	29·6	3·5	29·6	3·7	30·8	3·9	32·8	4·0
4 ..	30	Control	27·0	3·2	31·0	3·6	33·7	3·6	34·0	3·9	33·5	4·0

* Week of treatment.

Effect of Treatment upon the Infestation.—This could not be determined as no birds were available for examination.

Effect of Treatment upon Egg Production.—The actual egg production per bird per week of the treated pen (10) and of the control pen (4) are compared in Graph No. 11. It would appear from this graph that treatment did not at any time affect production, but that it had been responsible for immediately increasing the production, and thereafter maintaining it at the same level as the controls.

A consideration of the corrected figures of production showed that over the eight weeks in which treatment was applied, pen 4 produced 24·9 eggs per bird, and pen 10 31·0 eggs per bird respectively. As the standard error was only 1·01, the difference of 6·1 eggs is highly significant, and indicates that the treatment had been beneficial to this extent.

Effect of Treatment upon Food Consumption.—There was no significant difference between the two pens in the total amount of food consumed over the eight weeks period. Pen 4 consumed 249.8 oz. and pen 10, 234·6 oz. (standard error 7·76). When the ratio food consumed per bird per dozen eggs produced was compared, however, it was found that pen 10 required 90·93 oz. per bird, and pen 4, 121·44 oz. per bird (standard error 3·81). The control pen, therefore, required 30·51 oz. of food more than the treated pen to produce a dozen eggs, which difference is significant.

Discussion.

The results secured from these two experiments indicate firstly that further fields trials with nicotine sulphate as a flock treatment are desirable in which the application of treatment is carried over much longer periods.

GRAPH No. 11.

Flock Treatment with Nicotine Sulphate. Experiment 4.

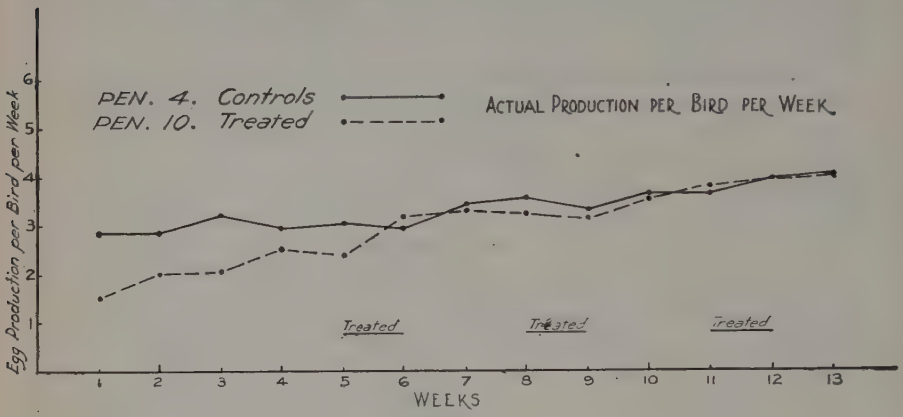


Plate 318.

Under the conditions governing the experiments, however, the following conclusions may be drawn:—

1. *Ascaridia galli* affects production, but in the case of birds on an adequate diet, and otherwise well cared for, the infestation must be heavy before any ill-effects are manifested. When such birds are exposed to a heavy infestation there appears to be a regular turn-over in the worm burden. That is, the infestation reaches proportions at which it may cause a marked decrease in production. Many of the worms are then lost, the effect of which is shown by a temporary increase in producton. Reinfestation rapidly occurs and production is again affected.

As the birds used in these experiments were also infested with *Davainea tetragona* and *Heterakis gallinæ* it might be said that any beneficial effects of treatment on production may not have been associated solely with the removal of *A. galli*, especially as treatment had some degree of efficiency against *H. gallinæ* as well. The cestodes were fairly evenly distributed among the treated and control birds, and the infestation with *H. gallinæ* was apparently never very heavy. The writer feels safe, therefore, in permitting himself to consider any favourable effects arising from treatment as being chiefly, if not entirely, due to the removal of the *A. galli*.

2. Birds heavily infested with *A. galli* consume more food per dozen eggs produced and convert less food into body weight.

That *A. galli* may have a very marked effect upon body weight is shown by the respective increases in weight per bird of the four pens of White Leghorn pullets over a twenty-seven weeks' period, during the last fourteen weeks of which two of the pens received treatment. These

increases in weight, together with the average number of worms per bird found in each pen at the conclusion of the trial, are, for the sake of emphasis, repeated in Table XXXIV.

TABLE XXXIV.

Number of Pen.	Increase in body weight over 27 weeks period.	Average number worms per bird at conclusion of trial.
	Oz. per bird.	
6 (control)	25·9	19·8
7 (treated)	26·2	6·8
8 (control)	20·2	51·1
9 (treated)	27·7	4·3

A consideration of these figures indicates little differences between the gains of pens 6, 7, and 9, but in the case of pen 8 the gain of only 20.2 oz. is conspicuously lower than that of any of the other three pens. It would, therefore, appear that the infestation of the control pen (pen 6) had never been sufficiently severe to affect growth, whereas in pen 8, which was also untreated, the infestation had been heavy enough to prevent the birds in this pen from gaining in weight to a normal extent. This would indicate that the figure at which an infestation commences to affect the body weight of young laying birds is somewhere between 20 and 50 worms, and that a worm burden of 50 or more worms is definitely pathogenic.

3. In the case of pen 7, treatment was followed by a period of decreased egg production on each occasion. With pen 9, however, while there are indications that a slight decrease following treatment did occur at times, such a decrease is not so constantly or so conspicuously associated with treatment. The treatment periods of the Australorps, on the other hand, showed no such effect at any time.

Pen 10, it will be remembered, contained aged birds (three years) of a heavy breed, whilst the birds in pens 7 and 9 were much younger birds (about eight months of age at the beginning of the trial) of a light breed. The birds in pen 7 were, moreover, in general apparently only lightly infested, so that there was little evidence that the infestation had affected the production of this pen to any marked degree, except towards the final periods of the trial. In pen 9, on the other hand, the infestation was heavy, and apparently was sufficiently severe to affect the health of the birds so far as production was concerned. A possible interpretation of the inconsistent behaviour of the three treated pens to treatment is, therefore, that the use of nicotine sulphate at the rate of ·5 ml. per pound of mash for a period of seven days may have been toxic to the younger birds. Where an infestation sufficiently heavy to affect production exists among such young birds, however, the continued employment of treatment by removing the worms and keeping them below the level at which they become pathogenic, increases production, the elimination of the infestations more than compensating for any toxicity associated with the treatment.

This interpretation emphasises the necessity for further trials in which the period of treatment is reduced to four days, for, as indicated from the laboratory trials, little increase in efficiency occurs when the treatment of birds over six months of age is continued beyond this period.

4. Treatment over seven days under field conditions and at monthly intervals is highly effective against *A. galli,* and moderately so against *H. gallinæ.* In these trials, as in the laboratory experiments, it is interesting to note that only small worms survived. Why this should be so is not understood, and, from the size of the worms surviving, cannot be explained as being due to the fact that during the time of treatment such worms were buried in the intestine tissues.

[TO BE CONTINUED.]

GROW MORE PASSION FRUIT.

There is a very much greater demand for passion fruit, both locally and for export, than Queensland produces, and as this State grows a passion fruit of the very highest quality, it should be produced to a greater extent than it is. As an occupation on the orchard, it is one of the most pleasant. Previously, production of this fruit has been chiefly undertaken as a sideline only—a kind of secondary affair, which, if it yielded a return, so much to the good; it it didn't, well, it did not matter a great deal. With the ever-expanding demand, it warrants being made a principal crop, and being subjected to kind treatment.

Vines are prone to several diseases, which, with proper attention, can be controlled, but which, when the vines are allowed to grow uncared for, quickly destroy them. Due to these diseases and the haphazard method of cultivation frequently employed in the past, the idea has become current among orchardists that vines can only be grown for about two or at most three years. That this is erroneous is being demonstrated at the present time by vignerons who have made passion fruit growing their main occupation, and who have vines bearing well at seven years of age. These growers, however, prune correctly, and spray at the correct times, as advised by the Department. They also grade and pack their product for market, and the result is they are reaping the benefit of an excellent monetary return.

It is stated by some that passion fruit growing entails too much work pruning and spraying, and the results are not worth it. A careful analysis of the position will refute such statements. Pruning the vine undoubtedly is a tedious and lengthy operation. Spraying also is objectionable, but remember that citrus growers, grape growers, and practically growers of all other kinds of fruit must also prune and spray their trees. So far as returns are concerned, good vines produce up to half a bushel of fruit per year. They are usually planted 15 feet by 8 feet apart, or 363 vines per acre. Prices vary from 22s. 6d. per half-bushel during the periods of scant supplies to 4s. 6d. per half-bushel paid by the local factories. From these figures, orchardists can estimate for themselves the likely returns. On a conservative average of 3s. 6d. per half-bushel clear of marketing expenses, the return would be £63 per acre per annum. Are there many other fruit crops netting orchardists this sum per acre?

A pamphlet giving full cultural details is available free on application to the Department of Agriculture.

Briefly, for the guidance of those who may be considering planting, it should be remembered that the passion vine is a climber, and thrives in warm, moist situations, preferably in the coastal districts. It grows well on the coastal highlands, like the Blackall Range and Tamborine Mountain, and also on the lowlands between the ranges and the sea. The vine will resist light frosts, but heavy frosts will cause damage.

Reasonably fertile scrub and forest loams, provided they are well drained, are suitable soils, and if a hillside site is chosen, it should be well sheltered from heavy winds and preferably have an easterly or north-easterly aspect. It is important that the trellises be strongly made, and that they be at least 6 feet in height.

Two crops are borne each year, a summer and a winter crop, whilst occasionally intermediate crops are borne.

Spring is the best time to plant, though autumn planting is sometimes practised. Spring-planted vines sometimes return a small crop the following winter, but the first main crop can be looked for twelve to fifteen months after planting. With autumn-planted vines, the first main crop is often not obtained until eighteen to twenty-one months after planting.

Principles of Botany for Queensland Farmers.

C. T. WHITE, Government Botanist.

[*Continued from p. 632, Nov., 1936.*]

Part IV.—CLASSIFICATION.

THE SYSTEMATIC ARRANGEMENT OF PLANTS IN GROUPS. ACCORDING TO THEIR AFFINITIES.

CHAPTER XIX.

General Notes on Classification.

THAT branch of botany which deals with the naming, describing, and arranging of plants into groups according to their natural affinities is termed systematic botany, and in the early days of the science practically every botanist's activities were devoted to it. This was only natural, as it is obvious that, owing to the very large number of plants known to inhabit the globe—somewhere about 150,000 flowering plants having been described, and possibly a greater number of cryptogramic ones—it is necessary to have as far as possible some uniform system of naming and classifying these multitudinous forms. One of the principal objects of systematic botany is to describe and arrange plants in such a way that, if one wishes to ascertain the correct name of any particular plant, one may do so by referring to some work in which the descriptions of the different plants are set forth on this plan.

Various systems of classification have been proposed from time to time. In any natural system all the characters exhibited by the plant, not only its external features, but its anatomy, life history, and—as far as possible—its genealogical history, are taken into consideration in placing it in its position in the system.

The Unit of Classification; the Species.—"A species is the smallest group of plants existing wild in nature, which can readily be distinguished from all other groups, owing to the fact that the individuals composing it all possess in common certain well-marked characters (specific characters) by which they can be distinguished from all other plants. The individuals also which compose the species are, when developed normally in a state of nature, always able to transmit their specific characters unchanged to the majority of their immediate offspring." (Hole—"Manual of Botany for Indian Forest Students.")

The species forms a natural unit upon which all other groups may be built.

In some works distinctions of groups of lesser importance than a species are attempted, but in the majority of systematic works on Australian plants—e.g., "Floras"—all are placed under the term "variety."

A variety is a group of plants subordinate to a species and generally with only a minor difference, such as size of leaf, colouring of flowers, &c., from the parent type. The differences may or may not be constant —i.e., they are not always transmitted unchanged from the parent to the majority of its immediate offspring,

The Genus.—Everyone is acquainted with the fact that certain groups of species resemble each other closely, but are yet quite distinct the one from the other; such species are grouped together by the

systematist and form what is spoken of as a genus. The Blue Gums, Stringybarks, Boxes, and Ironbarks, for instance, are trees that resemble one another more or less in their general features; they all have oil-bearing leaves; their calyx lobes are welded together to form a little cap (operculum) which fits over the young sexual parts of the flower, falling off at their maturity; they all have dry seed capsules with small angular seeds—in other words, they are all Eucalypts, or "gum-trees," or, in the terms of systematic botany, different species of the one genus.

Botanical Names.—The present system of naming plants is known as the binomial system, and was introduced into botanical and zoological work by Carl von Linné (generally Latinised as Linnæus). Every plant has two names—firstly, the generic name or name of the genus (corresponding to the surname of a person), and, secondly, the specific name or name of the species (corresponding to the christian name or baptismal name of a person). Every plant of the same genus has the same generic name; so that all plants belonging to the Eucalypt or gum-tree genus bear the common generic name of *Eucalyptus*, while the various species are distinguished by their specific names—*e.g., Eucalyptus maculata* Spotted Gum), *E. crebra* (Narrow-leaved Ironbark), *E. microcorys* (Tallowwood). The same specific name can be used for only one plant in the same genus; thus we cannot have two species called *Eucalyptus maculata.*

The Natural Order or Family.—As groups of species are placed together in genera, so the genera in their turn are collected together to form still larger groups—viz., natural orders or families; thus the species comprising the genera *Eucalyptus* (Gum-trees), *Melaleuca* (Tea-trees), *Tristania* (Swamp Mahogany), *Leptospermum* (Wild May), and a number of others resembling one another in all possessing certain characters in common—as simple, undivided, oil-bearing leaves—go to form the large family Myrtaceæ.

The Larger Groups.—The type of grouping which has just been described is continued through the whole of the vegetable kingdom. The families are collected together in groups called series, the series into sub-classes and classes, the classes into subdivisions and divisions, and the lastmentioned into sub-kingdoms (of which there are only two), which naturally lead to the kingdom.

To take as an example the Spotted Gum, we can trace it down through the various groups just mentioned, starting with the largest or highest and working down the scale to the lowest or smallest. Thus:—

The Vegetable Kingdom.

Sub-kingdom: Phanerogamia.

Division: Embryophyta Siphonogama.

Subdivision: Angiospermæ.

Class: Dicotyledoneæ.

Sub-class: Archichlamydeæ.

Series: Myrtifloræ.

Family: Myrtaceæ.

Genus: Eucalyptus.

Species: Maculata.

The Sub-Kingdoms.—Of recent years there has been a tendency by many botanists to drop the use of the term *Phanerogams*[1] for the flowering plants and substitute the terms *Spermatophytes*[2], and Engler and Prantl, in their system, now largely used by botanists, proposed the name *Siphonogams*[3] for them. In all cases the terms *Cryptogams*[4] is retained for the flowerless plants. The name *Phanerogam* is still in general use among the majority of people, and in the following pages we will continue to speak of the two great divisions of the vegetable kingdom as Phanerogams or Flowering Plants and Cryptogams or Flowerless Plants. The great distinction between the two groups lies in the fact that reproduction in the former is carried on mainly by seeds, many-celled structures, each of which contains an embryo or young plant. On the other hand, seeds are never formed in the Cryptogams, reproduction being mainly effected by means of minute one-celled bodies termed spores.

CHAPTER XX.

Main Divisions of the Vegetable Kingdom.

Plants may be divided into six more or less natural and well-defined groups. These, in the accepted order of their development, starting with the lowest are: (1) The Myxomycetes or Mycetozoa; (2) Thallophytes; (3) Bryophytes; (4) Pteridophytes; (5) Gymnosperms; (6) Angiosperms. The plants included in the four groups together form the Cryptogams or flowerless plants, and the two last the Phanerogams or flowering plants, or Spermatophytes or seed-bearing plants.

THE MYXOMYCETES.—The Myxomycetes or Mycetozoa are commonly spoken of as the "Slime Fungi," and are regarded as a very lowly group on the borderland between plants and animals. The species are almost entirely saprophytic, living on decaying organic substances, such rotting leaves or wood, animal excreta, &c., and are devoid of chlorophyll.

A very few are parasitic, the best-known of these being *Plasmodiophora brassicæ,* which is the organism responsible for the "Club Root" or "Finger and Toe" disease of Cruciferous plants (turnips, cabbage, cauliflower, and garden flowers, such as wall-flower, candytuft, &c.). Like other lowly forms, many of the species have a wide—practically world-wide—geographical distribution, some of the species recorded for Australia being also found in Europe, Asia, Africa, and North and South America.

In their vegetative condition they consist of a naked mass of protoplasm—a plasmodium—capable of movement and resembling a gigantic amœba. The plasmodium, after a time, gives rise to either a single spore-producing or fruiting body—a sporangium—or it may divide into a number of parts, each of which develops into a sporangium. The external part of the plasmodium hardens to form the wall of the sporangium, while the internal part divides up into a number of cells, each of which provides itself with a cell-wall and becomes a spore. The cell dies, becomes ruptured, and the spores escape. After germination

1. From the Greek *phaneros,* manifest or plain, and *gamos,* marriage.

2. Greek *sperma,* a seed; *phyton,* a plant.

3. Greek *siphon,* a tube; *gamos,* marriage—referring to fertilization by means of a pollen tube.

4. Greek *cryptos,* hidden; *gamos,* marriage.

the outer membrane or wall of the spore bursts and a slimy mass of protoplasm escapes; this is provided with a minute flagellum by means of which it may creep about or may actively swim about in water, when it is said to be in the mastigopod stage. Later the flagellum is withdrawn and it creeps about by means of simple projections or protusions known as pseudopods, this being called the amœboid stage. The *myxamœbæ,* as they are called, collect together, forming the plasmodium. The plasmodium now gives rise to the sporangia, and the life-cycle is again repeated. In most of the Myxomycetes part of the internal protoplasm of the sporangium—before spore formation—is modified to form a number of threads, making what is known as a capillitium.

THALLOPHYTES.—The Thallophytes (or Thallophyta) constitute a very large group of plants characterised by their simple structure. The bodies of plants comprising it show no distinct differentiation into roots, stems, leaves, &c., and have no woody or vascular system. Such a simple vegetable body is spoken of as a thallus. Many of the lower forms are unicellular, but in the higher ones the thallus may be multicellular and attain a great size (*e.g., Macrocystis pirifera,* a seaweed of the southern seas, is said to attain a length of 700 feet). The Thallophyta may be subdivided into four well-differentiated and natural groups—viz., (1) algæ; (2) fungi; (3) bacteria; (4) lichens.

Algæ.—The algæ are mainly aquatic, and may be unicellular or multicellular and attain a large size. They may inhabit either fresh-water streams and pools or salt water, the larger forms of those inhabiting the latter being familiarly known as "seaweeds." The algæ contain chlorophyll, but the chlorophyll is often masked by other pigments, and on this account they have been roughly divided into divisions known respectively as the green, brown, red, and blue-green algæ. The red and the brown algæ are mainly marine (seaweeds). Reproduction in the simple forms may be by simple cell division, and in the higher forms may be asexual or sexual by means of spores.

The Fungi.—One of the chief characteristics of the fungi is the complete absence of chlorophyll in all the species; other pigments may be present, but in the absence of chlorophyll fungi are dependent on living or decaying vegetable or animal matter for their carbonaceous food—i.e., they are either parasitic or saprophytic.

A few are symbiotic, living in intimate relation with chlorophyll-containing plants without injuring them, as where they occur in association with roots forming mycorhiza. Probably the best-known form of symbiosis is where they live with algæ, forming lichens.

The thallus or body of a fungus is composed of filamentous threads termed hyphæ; it may be divided into two distinct parts—viz., (1) a vegetative portion termed the mycelium or spawn, and (2) a more or less specialised portion bearing the reproductive organs or spores.

The mycelium consists usually of a number of loosely interwoven hyphæ whose function is to absorb nutritive material from the host plant or medium in which the fungus grows. In parasitic sorts the hyphæ may either penetrate the cells of the host plant or simply ramify between them. In the saprophytes the mycelium may attain a large size, presenting masses of hyphæ of a cobwebby or cottony appearance, as may be often seen in manure heaps, decaying leaf-mould, &c. In some

species, (*e.g.*, those of the genera Cordyceps and Isaria) it penetrates the larvæ of insects, eventually killing them and filling the body of the larvæ with hyphal threads.

Very often the hyphæ are interwoven to form a thick, felty or woody mass of false tissue (i.e., it is formed by the interweaving and growth of the hyphæ—not by cell division). This is the case with the spore-bearing portion of the larger fungi, such as the mushrooms and toadstools.

Reproduction is by means of spores which may be either sexually or asexually produced. In one group—the yeast fungi—no distinct mycelium and reproductive portions are present, the plants being unicellular. As many of the fungi are parasitic upon and very harmful to other plants, they form a group of great importance to the agriculturist.

Bacteria.—Like the fungi, bacteria are quite devoid of chlorophyll. One of the chief characteristics of the group is the extremely minute size of the individuals, most of the species in at least one direction measuring somewhere about 1/20,000 or 1/25,000 of an inch. They are sometimes spoken of as the Schizomycetes or splitting fungi. They have been placed as a subdivision of the fungi, but are probably best regarded as a distinct group of the Thallophyta.

The bacteria which live in the nodules that occur on the roots of leguminous plants have already been referred to. They are able to fix the free nitrogen of the atmosphere and pass it on in the form of nitrogenous compounds which can be used by the associated plants as food, this source of nitrogen not being otherwise available to them. On the other hand, the bacteria receive from the green plant the carbon, minerals, and water required for their own development, this being a case of true symbiosis. These nodule-producing bacteria occur in most soils, and make their way through the epidermis into the centre of the root, where they induce an exuberant growth of parenchymatous tissue, resulting in the formation of the well-known root nodules. After a time the bacteria—which on first entering the root tissue are minute rods (bacilli)—change their shape and increase considerably in size and are then termed bacteroids. In this form they are gradually absorbed by the green plant, and transformed into nitrogenous compounds which are either utilised by the plant as food or stored away as reserve material. Numbers of them, however, are returned to the soil, thus providing for the infection of other leguminous plants. It will easily be seen, therefore, how it comes about that leguminous plants are so valuable as green manures, the nitrogen stored by them—mainly by bacterial action—being returned to the soil on their decay, when it becomes available to other crops that may afterwards be grown on the same land.

Lichens.—The lichen plant consists of a thallus built up by a fungus and alga living together and usually supposed to be in symbiotic relationship. The lichen or thallus is said to be foliose or foliaceous when the thallus is a flat structure adhering more or less loosely to the substratum on which it grows; on the under surface of the thallus are usually developed a number of rootlike bodies termed rhizoids, which serve as organs of attachment. When the thallus adheres so closely to the substratum that it forms an almost inseparable crust from it, it is spoken of as a crustose lichen. When the thallus is erect or pendulous and branching freely in all directions, it is said to be fruticose; the

various species of *Usnea,* colloquially known as "Old Man's Beard," are familiar examples of this type of lichen, and may be seen hanging down in greyish-green beardlike masses from dead limbs of trees, old wooden fences, &c. As may be supposed, intermediate conditions between these forms are met with.

Lichens are very familiar plants, and are found growing on soil, rocks, bark of trees, and dead wood. As a whole, they are of little economic importance, though in colder countries some of the species are used medicinally, and some in the preparation of dye-stuffs. Like other plants, they act as purifiers of the air, and aid in the reduction of rocks to soil. Their principal interest to the farmer, however, lies in their relationship to the health of trees, and in this respect we cannot do better that quote a well-known authority on the group—Mr. Bruce Fink. In his work "Lichens of Minnesota" (Contributions from the United States National Herbarium, Vol. 14, p. 36) he says:—"In France and other countries of Europe foresters have supposed that lichens are injurious to trees, and have to a limited extent practised scraping the larger ones from the bark, along with certain other fungi. However, it would be difficult to accomplish much in this way in large forests, even were it known that the lichens are very injurious to the trees. In the United States M. B. Waite, while experimenting with fungicides on fruit trees, noted that Bordeaux mixture killed the lichens very effectually. He is not at all certain that the lichens are injurious to the trees, but thinks that they at least may interfere with the functions of the bark. It is true that the more conspicuous foliose lichens are more common on unhealthy trees than on thrifty ones; but the question remains whether the lichens have worked the injury to the trees, or whether unhealthy trees are more easily penetrated by the rhizoids of the lichens, and also whether they furnish some food materials for the lichens not present in healthy trees or not easily obtained from them. It is probably not worth while to take time to remove lichens from any trees of temperate regions for the sake of saving the trees from injury."

Bryophytes.—The Bryophytes (or Bryophyta) include two sub-groups—the Liverworts and Mosses. Neither group is of any particular importance to the farmer, and space allows little more than a mere mention of their existence. The latter group is familiar to almost everyone, but the former is less generally known.

The Liverworts (or *Hepaticæ*) are of a lower type than the mosses, and the body is either a thallus or may be differentiated into stem and leaves, the latter being only one cell in thickness and devoid of a midrb. There is no trace of even a rudimentary vascular tissue. In the Mosses (or *Musci*) the body is differentiated into stem and leaves, and the latter, in most cases, possesses a distinct midrib several cells in thickness. Commonly the central portion of the stem and the midrib of the leaf is composed of specially differentiated tissue that serves for the conduction of water and assimilated food, and represents a rudimentary vascular system; there is no true wood or vessels, however, as in the higher plants.

Information in regard to further characteristics of the Bryophytes, their life history, &c., will have to be sought for in more general botanical text-books.

PTERIDOPHYTES.—In the Pteridophytes (or Pteridophyta) a distinct woody or vascular system is first met with, and they are often therefore referred to as the Vascular Cryptogams. They fall naturally

into several well-differentiated subdivisions, by far the two largest being the Ferns and the Lycopods or Club Mosses. Of the second of these groups—the Club Mosses—a great many of the species possess considerable beauty, and on this account are largely cultivated in plant houses for ornamental purposes, species of *Lycopodium* (Tassel Ferns) and *Selaginella* being plants well known to gardeners; they are, however, of no particular interest or importance to the farmer, and, as with some other cryptogamic plants, information regarding them will have to be sought for in the more general text-books of botany.

The first-mentioned plants—the Ferns—though, with the exception of the common Bracken, of no particular importance to the farmer, constitute a group a number of the members of which are so plentiful and such a characteristic feature of the landscape that some reference to the general characters of the group may not be deemed out of place. The leaf of the fern plant is termed a frond; the veining is usually forked, and the very young frond is coiled in the bud stage. Most fern stems are herbaceous and take the form of a rhizome, which is often creeping, as in the common Bracken (*Pteridium aquilinum*); in other cases it is short and tufted, as in the Mountain Bracken (*Balantium dubium*); in some it is climbing, attaching itself to rocks or tree trunks by means of numerous adventitious roots, as in *Arthropteris tenella, Polypodium scandens*, &c., or may climb by twisting round some support or scrambling over shrubs and trees, as in the Climbing Maiden Hair (*Lygodium scandens*).

In some cases the stem is upright and may form a trunk of several feet; these are the well-known Tree Ferns. The vascular bundles in the ferns are closed; hence there is no secondary growth in thickness.

Reproduction is by means of spores. The spores are borne in little cases termed sporangia (singular, sporangium), and the sporiangia are collected in groups called sori (singular, sorus), usualy borne on the back of the frond, and in the majority of ferns occurring in the form of little, round, yellowish or brown masses; they are often protected by a little shieldlike outgrowth of the leaf-tissue known as an indusium.

The spores are released by the rupture of the sporangium, and, on reaching a suitable medium, germinate and grow out into a tube, or, rather, a string of cells, which later develops into a small, green, flat, heart-shaped plate of tissue—the prothallus—bearing on its under surface a number of root-hairs and rhizoids. The prothallus is important, as it represents a distinct phase in the life history of the fern plant; it is homologous with the thallus or plant body of the liverworts and mosses, and on its under surface are borne the sexual reproductive organs—the antheridia or male sexual organs, and the *archegonia* or female reproductive organs.

When mature, provided sufficient moisture is present, these burst and a number of spermatozoids or actively moving male cells are discharged from the antheridia. The archegonium is provided with a short neck, which on maturity bursts or opens at its apex; below the neck and deeply embedded in the tissue is the ovum or egg-cell. The spermatozoids, attracted by an exudate of the archegonium, make their way to it, and one or more pass down the neck and fuse with the egg-cell, resulting in the formation of a zygote. This surrounds itself with a cell-wall, and is the starting point of a new fern plant similar to the parent. For a time the embryo remains attached to the thallus by means of a special

organ termed the foot, from which it obtains its nourishment through its own leaves and roots; the prothallus then usually withdraws and dies away, and the embryo continues to grow until it develops into a plant similar to the parent from which it originated.

GYMNOSPERMS and *ANGIOSPERMS.*—These two groups together constitute the sub-kingdom *Phanerogamia* (Phanerogams), and, as they possess many characteristics in common, it is convenient to treat them together. The chief difference that separates them from the Cryptogams is that, in place of reproduction being mainly carried on by means of spores, the sexual process results in the formation of the seed, by means of which reproduction is carried on; on this account they are often termed the *Spermatophyta,* or seed-bearing plants. Another difference separating them from the Cryptogams is that the male reproductive cell is carried to the female cell by a tube thrown out from the pollen grain, and on this account they have been termed *Siphongamia.* Another and less important distinction lies in the fact that the male and female organs—which are very distinct—are borne on specially modified shoots which we term flowers. There is scarcely any need here to go into the morphology, anatomy, and life history of the flowering plants, as these have already been dealt with in previous chapters. It may be as well, however, to outline briefly the distinctions between the two groups.

The distinguishing characters of the Gymnosperms are:—The "flowers" are without perianth leaves, the ovule is not enclosed in an ovary, and the pollen grains enter the micropyle and come to lie directly on the surface of the nucellus; the male reproductive cell in the lower forms is a spermatozoid. The endosperm of the seed is formed before fertilisation. Vessels (pores)—except in the Gnetaceæ—are absent from the wood.

Angiosperms.—The distinguishing characters of Angiosperms are: The flowers, except in some of the lowest forms, possess a perianth; the ovule is enclosed in an ovary, and the pollen grain, instead of coming into direct contact with the ovule, is received and germinates on a specially modified area—the stigma, an organ which is missing in the Gymnosperms. The male reproductive cell is never a spermatozoid, and the endosperm and perisperm are formed mostly after fertilisation and probably as a result of it. The wood, in almost all cases, contains true vessels.

Further Subdivisions: *Gymnosperms.*—The Gymnosperms have been divided into four classes—the Cycadales, containing the family Cycadaceæ; the Gingkoales, containing only one living member—*Gingko biloba,* the Maidenhair Tree of China and Japan (family Gingkoaceæ); the Coniferæ, containing seven more or less well-differentiated families; and the Gnetales, containing three small families.

Of these, the Cycadaceæ are plants of fernlike growth, of some importance to the farmer and grazier as plants poisonous to livestock; the Australian members of the family are dealt with in a special chapter.

The Coniferæ constitute a group of the most importance, as coniferous woods form the world's main supply of commercial timber. The most recent classification divides the Conifers into seven families.

The Gnetales form a group now divided into three small families of diverse form—viz., the Ephedraceæ, with about 35 species, growing in the arid areas of the Mediterranean regions, Asia, North America, and

South Africa; the Welwitschiaceæ, containing a single species—a remarkable plant (*Welwitschia mirabilis*)—a native of Western South Africa; and Gnetaceæ, with about 30 species, trees or woody climbers of the rain-forests of tropical America, Asia, and New Guinea. The Gnetales differ from all other Gymnosperms in that the wood contains true vessels. No species, however, occurs in Australia, and the group is one of little or no importance to the Australian agriculturist or forester.

Angiosperms.—The angiosperms have been divided into two classes —(*a*) the Monocotyledons, and (*b*) the Dicotyledons.

The Monocotyledons are characterised mainly by the embryo containing a single cotyledon; the floral members mostly occur in whorls of three, and in many cases the perianth leaves are alike and petaloid. The leaves are mostly parallel-veined, reticulate veining being rare—though it occurs in the family Araceæ—*e.g.,* Cunjevoi (*Alocasia macrorrhiza*) and the numerous garden varieties of Caladium. The stem or trunk is not distinctly divided off into pith, wood, and bark; the vascular bundles are closed; hence secondary thickening, except in a few exceptional cases, does not take place.

The Dicotyledons are characterised mainly by the embryo containing two cotyledons. The floral members mostly occur in whorls of five or four, though in this respect the flowers vary very considerably, and the perianth is usually distinctly differentiated into calyx and corolla. The leaves are reticulate-veined, and in the majority of cases are distinctly divided into petiole and blade. The vascular bundles of the stem are arranged in a ring and are open, so that secondary growth in thickness in all the larger plants takes place. Distinct pith, wood, and bark are usually present in the woody species.

The Dicotyledons constitute probably about three-fourths of the flowering plants of the world.

They are again divided into two sub-classes—(*a*) the Archichlamydeæ, and (*b*) the Metachlamydeæ or Sympetaleæ.

In the Archichlamydeæ the perianth is either absent or rudimentary (*e.g.,* She-oaks or *Casuarinaceæ*), in one whorl (*e.g.,* Silky Oaks or *Proteaceæ*), or in two whorls, in which case the parts of the inner whorl (corolla) are free.

In the Metachlamydeæ the perianth is in two whorls, the corolla is gamopetalous, and the stamens are often epipetalous.

CHAPTER XXI.

Gymnosperms.

The Gymnosperms, according to the latest classification, are divided into seven classes. They are an ancient group, and of these seven classes three are fossil only. The four living classes are the Cycadales, Gingkoales, Coniferæ, and the Gnetales.

The Cycadales or Cycads.

The Cycadales contain a single family—the Cycadaceæ. They are plants of palmlike or fernlike growth and of little economic importance. The leaves are once or twice divided. The plants are dicecious—*i.e.,* either male or female. The male flowers are borne in comparatively large cones consisting of numerous spirally arranged scales, each scale bearing

on the under surface numerous anthers. The females are borne in a loose cone breaking up into several-seeded, leaflike, simple, distinct seed-leaves, as in Cycas, or form distinct cones consisting of numerous scales, each with two pendulous ovules. The cones often become very large when fully developed.

The family is represented at the present day by about seventy species divided into nine genera, and widely spread through the tropical and subtropical regions of the world. Three genera occur in Australia —namely, Cycas, containing six species, Macrozamia, containing twelve species, and Bowenia, containing two.

Cycas is confined to the tropical zone, and contains four species in Queensland, and two in the north-west of Western Australia. The members always form a distinct trunk, and in leaf only can be distinguished from arborescent species of Macrozamia by the leaf segments, which always possess a distinct midrib. The most widely distributed species in Queensland is *Cycas media,* abundant in Eucalyptus forests from Rockhampton to the extreme north of the State and stretching over to the southern part of the island of New Guinea. The other species in Queensland, so far as records go, are confined to one or two localities, but are very imperfectly known.

Macrozamia is represented in Australia by about twelve species, but the differences between some of them are not at all clear. One or two have a comparatively large range; others are confined to restricted areas.

Bowenia is distinguished from other Cycads by the leaves being bipinnate. The genus is endemic in Queensland, being represented by two species—namely, *B. spectabilis,* widely spread in the north-eastern portion of the State, and *B. serrulata,* confined to Byfield, near Keppel Bay.

Zamia, Zamia Palm, or Zamia Fern are various popular names given in Queensland to different species of Cycads. In addition, Burrawang or Wild Pineapple is a name frequently given to species of Macrozamia, particularly to *M. spiralis.* All the Australian members have a bad reputation as plants poisonous to stock. Following serious losses with travelling sheep in New South Wales, which had eaten freely of the seeds of the common Burrawang (*M. spiralis*), feeding tests were carried out at the Veterinary Research Station, Glenfield, New South Wales, by Dr. H. R. Seddon. No poisonous principle has been isolated from these plants, but Dr. Seddon states that from the lesions produced it would appear that the toxin is a specific protoplasmic poison having the selective action of endothelial cells. The pith of the stem is rich in starch, and has been used as a stock food. The poisonous properties, which are contained in the pith as well as the roots, leaves, and seeds, are readily removed by heat.

The Gingkoales.

The class Gingkoales, consisting of a single family (*Gingkoaceæ*), is of little importance to Australian foresters or agriculturists. The only living member (*Gingko biloba,* the Maidenhair Tree, a native of China and Japan) is a relic of a one-time widely spread and species-rich group. The tree is sometimes seen in Queensland gardens.

The Coniferæ or Conifers.

The Conifers constitute a group of great economic importance, as from coniferous forests is drawn the world's main supply of commercial timber.

Many botanists have proposed different classifications for the group. The most recent—that of Pilger in the second edition of Engler's "Pflanzenfamilien"—divides them into seven families. These seem naturally fairly well defined. The system proposed has much to recommend it, and will probably be adopted by most botanists. The seven families proposed are: (1) *Taxaceæ;* (2) *Podocarpaceæ;* (3) *Araucariaceæ*; (4) *Cephalotaxaceæ*; (5) *Pinaceæ*; (6) *Taxodiaceæ*; (7) *Cupressaceæ.*

Family Taxaceæ (The Yews).

Taxaceæ as now defined contains only only three genera—namely, *Torreya,* from temperate Asia and North America; *Taxus,* a Yew from Europe and North America; and the remarkable *Austrotaxus,* confined to a very limited area in New Caledonia. They are trees or shrubs with linear, needle-shaped or narrow leaves. The male flowers are axillary and single, or (in *Austrotaxus*) borne in very small spikes (amenta). Each stamen bears 2-8 anthers; the female flowers are borne on short axillary shoots with a single terminal ovule, and are surrounded at the base with numerous bracts. The seeds possess an arillus.

Family Podocarpaceæ (The Podocarps).

Podocarpaceæ as now defined contains seven genera, five of which occur in Australia. They are trees or shrubs with scalelike, needle-shaped, linear-lanceolate or even broadly ovate leaves. In one genus—*Phyllocladus*—the leaf functions are carried on by flattened branches or phylloclades. The male flowers are borne on leafy shoots, terminal or axillary, and mostly have an elongated axis with numerous stamens. Each stamen bears two anthers; the female bears one or several carpels always with only a single ovule. Cotyledons two. Of the five Australian genera, only one—namely, *Podocarpus*—occurs in Queensland. It is a genus of somewhat resinous trees or shrubs. The leaves are variable, but in Queensland species are alternate and flat and (except in *P. Ladei*) with a prominent midrib. The male flowers are in cylindrical amenta, the scalelike apices closely packed, each scale bearing two anther cells. The female flowers usually possess 3-4 sporophylls, one or two of which bear in their axils a fertile scale folded over and united to an inverted ovule, but usually only one matures. In many species the sterile scales or sporophylls often fuse with the upper part of the stalk to form a fleshy receptacle below the seed. The outer seed coat may be dry or fleshy.

Podocarpus is a widely distributed genus represented in Australia by seven species, five of which occur in Queensland. The only species of any importance as timber trees all occur in Queensland, one of these—*P. elata,* the common She Pine or Brown Pine—stretching into New South Wales.

Family Araucariaceæ (The Bunya, Hoop, and Kauri Pines).

Araucariaceæ is a family of large trees with broad, narrowly-lanceolate or needle-shaped and spreading or small imbricate leaves. The trees are typically monœcious—*i.e.,* the male and female flowers are distinct but borne on the same tree—though apparently sometimes diœcious, due to the preponderance of one sex on certain trees. The male flowers are borne in cylindrical amenta in the leaf axils or terminating short shoots. The male sporophylls are closely packed, and bear 3-20 anther cells or stamens on the lower surface. The female amenta terminate short branches, and are composed of numerous imbricate scales or sporophylls,

each bearing a single ovule. The mature cones are mostly globose or somewhat globose in form, and vary from the size of an orange to that of the human head.

The family consists of two genera, both of which are represented in Australia—namely, *Araucaria* and *Agathis*. They are fundamentally differentiated as follows:—

Seeds united with the ovuliferous scale or female sporophyll	*Araucaria*
Seeds quite free from the scale	*Agathis*

At present the family is almost confined to the Southern Hemisphere.

The genus *Araucaria* at present is only found in the Southern Hemisphere, the species being distributed through South America, New Caledonia, New Guinea, and Eastern Australia. The only two Australian species (*A. Bidwillii* and *A. Cunninghamii*) are both found in Queensland, the latter stretching into northern New South Wales. In past geological times *Araucaria* had a much wider range than at the present day, there being abundant geological evidence in different parts of the world that during the Jurassic period *Araucaria* trees existed closely related to the existing ones. The genus is divided naturally into two very distinct sections—

(*a*) In which the cotyledons remain under the ground, the leaves flat and spreading and the cones very large. The seed scales and seeds are heavy and are not wind-borne;

(*b*) In which the cotyledons come up out of the ground, the leaves on adult trees are small and imbricate, and the cones are comparatively small (about the size of a large orange). Sporophylls and seeds are comparatively light and wind-borne for at least a short distance.

Of the two Australian species, *Araucaria Bidwillii*, the Bunya Pine, belongs to the former group, and *A. Cunninghamii*, the Hoop Pine, to the latter.

Agathis is a genus of trees in many cases very large. The leaves are flat, broad, and alternately arranged. The leaves on young trees or coppice shoots are not markedly different from those on the adults, though, generally speaking, they are somewhat larger and broader. The mature cones are comparatively large—usually somewhat larger than a cricket ball—the scales thin, scarcely woody, broadly wedge-shaped, and closely appressed. The seeds are oblong-cuneate, deeply emarginate or truncate at the apex, with both or one of the lateral edges produced into a membranous wing.

Agathis is a widely spread genus, 12-20 species—according to the view taken of the limits of the different kinds—being known. The genus is almost wholly confined to the Southern Hemisphere, stretching from New Zealand through New Caledonia, the Solomon Islands, and Queensland to Malaya and the Philippine Islands. The resin, which exudes freely from the wounds, is found in some countries, notably in New Zealand, in a fossil or semi-fossil state in huge quantities on the site of ancient Kauri forests. The fossil gum is regarded as superior to the fresh gum and brings a higher price. Both are extensively used in the manufacture of varnishes. So important is the resin regarded that in some countries—for instance, the Philippine Islands, Borneo, and other parts of the Malay Archipelago—it is regarded as the chief

product of the tree rather than the timber, as is the case in Queensland. The common Malayan species is *Agathis alba*, and has a wide range through the Philippine Islands, Cochin China, the Malay Peninsula, and several of the islands in the Malayan Archipelago. The resin is commercially known as Manila or Borneo copal or dammar.

Agathis robusta is the common Kauri Pine of Southern Queensland, and is confined to the Wide Bay district; having been operated heavily upon in the past, large trees are now very rare.

Agathis Palmerstoni is the common Kauri Pine of North Queensland and has a comparatively limited range in the coastal ranges of the Atherton Tableland and the Cairns timber district.

Family Cephalotaxaceæ.

Cephalotaxaceæ is a small family of two genera—*Cephalotaxus* and *Amentotaxus*. It is confined to the Himalayan region, China, and Japan. The members are small or medium sized trees, regarded by most botanists as very closely allied to the true *Taxaceæ* (Yews and their allies).

Family Pinaceæ (The True Pines).

The family *Pinaceæ* as now limited is confined to the Northern Hemisphere and consists of trees with needle-shaped, spirally arranged leaves. The flowers are monœcious, males and females being found on the same tree. The male flowers are usually numerous and spirally arranged in a dry spike (amentum). Each consists of an anther scale bearing two anthers on its lower surface. The female amenta are composed of numerous bracts, each with an ovule-bearing scale in its axil, the whole ripening into a hard, woody cone. The seeds are two at the base of each scale and are usually winged.

From the Pinaceæ is drawn the main bulk of the world's supply of softwoods. For the most part, the species are gregarious, forming the coniferous forests of the Northern Hemisphere.

The largest genus is *Pinus*, which contains the true Pines. It consists of about seventy species and is confined to the Northern Hemisphere, where it has a wide range from the limit of tree growth in the Arctic Circle to the tropics of Asia and America. In the tropics the trees are usually confined to more or less temperate altitudes and are rarely found on the plains. Apart from their value as timber producers, pines have other economic uses. Several species yield, by tapping, an oleo-resin which on distillation yields tar-oils, turpentine, pitch, &c., Pine-leaf oil, procured by distillation of the leaves, is largely used medicinally. The leaves are sometimes reduced to fibre, which is used for weaving into medicated underclothing, for surgical dressings, for stuffing upholstery, and in the manufacture of coarse matting. The seeds of some species are largely used for food in the countries in which they grow.

A number of Pines are cultivated in Queensland, particularly on the Darling Downs and in the Granite Belt. The commonest of these is the Insignis Pine (*Pinus radiata*). This Pine was introduced into England in 1831-32 by David Douglas, an English botanist, who gave it the manuscript name of *Pinus insignis*. Soon afterwards more material was received, and D. Don described and published it under the name of *Pinus radiata*. As this was the first published description, *radiata* is the name that should stand.

The late Professor E. H. Wilson, one of the greatest authorities in the world on the trees of the Southern Hemisphere, stated in one of his articles that it rather looked as if this tree would prove the Northern Hemisphere's greatest gift to the forests of the South, including Australia, New Zealand, and South Africa. He goes on to state that it surprised him to find a species so rare as a wild tree and of so little value in its native land to be of such immense importance in the Antipodes. In the Southern Hemisphere the wood of the Insignis Pine is superior to that of the same tree growing in California, its native state.

Other Pines commonly seen in Queensland gardens and parks are the Aleppo Pine (*P. halepensis*) and the Chir Pine (*P. longifolia*).

Family Taxodiaceæ.

Taxodiaceæ is a family of trees with scalelike, large, needle-shaped or falcate leaves. The male flowers are borne in small terminal or axillary amenta. The female flowers are borne in terminal amenta which are solitary and composed of numerous spirally arranged, ovule-bearing scales. The mature cones are woody or hard-leathery. The seeds are 2-9 to each scale and usually have a narrow, winged edge. The family contains some extremely important genera—for instance, *Sequoia,* containing the Californian Redwood and the Big Tree, *Taxodium,* the Swamp Cypress, *Cyrptomeria,* the Japanese Redwood, and *Athrotaxus,* the King William Pine or King Billy Pine of Tasmania.

Family Cupressaceæ (The Cypress Pines and Junipers).

The family *Cupressaceæ* is a family of much-branched shrubs or trees. The leaves are decussate—*i.e.,* opposite, with the one pair at right angles to the adjoining pair, or in whorls or three. Those on young trees or barren branchlets are needle-shaped and spreading; those on the adult tree mostly scalelike or appressed closely to the branchlet; more rarely, as in some Junipers, they are needle-shaped and spreading. Both male and female amenta are terminal or axillary and with the scales opposite or whorled. The anther-bearing scales are broad and bear 3-5 free anthers. The cones are woody, as in the Cypress Pines, or fleshy, as in the Junipers. The seeds are 1-3 in each cell and may be winged or wingless.

In Australia the most important genus of the family is *Callitris,* a genus of small or medium sized trees, containing nineteen described species—with the exception of one in New Caledonia—confined to Australia. Unlike the other Australian genera of Conifers, it is represented in every State of the Commonwealth.

The systematic economic products, chemistry, and anatomy have been exhaustively studied by Messrs. R. T. Baker and H. G. Smith, and the results published in their large work "A Research on the Pines of Australia." One of the principal features in regard to timbers of the Australian Cypresses is their comparative power of resistance to the attacks of termites (white ants), probably due to the presence in the wood of a phenol and other chemical bodies. In addition to their value as timber trees, at least two of the species—*C. columellaris* (the Sand Cypress) and *C. calcarata* (the Black Cypress)—possess barks with a high, but very variable, tannin content. The inner bark also contains an oleo-resin, which when the bark is injured exudes in tears,

the resin being variously known as "Pine Resin," "Cypress Pine Resin," or "Australian Sandarac." It is particularly well suited for the manufacture of pale spirit varnishes.

CHAPTER XXII.

Angiosperms (Monocotyledons).

SOME OF THE PRINCIPAL FAMILIES.

There has been considerable difference of opinion as to the limits of the main plant families of recent years. The present tendency is to divide the larger families of the older classifications into several smaller ones. In the system of Bentham and Hooker adopted in most of the older works in Australia on plants only twenty-three families of Monocotyledons were recognised. Engler and Prantl, by subdividing some of the larger ones, increased the number to thirty, and Hutchinson, in his recently published "Families of Flowering Plants," recognises sixty-seven.

Eleven of the more important families or natural orders have been selected and their characters briefly outlined for the present work. The limits of the families are those of the Engler and Prantl system.

Family Gramineæ (The Grasses).

Grasses are annual or perennial plants, in one group—the bamboos—attaining the size of shrubs or trees. The stems are erect or creeping, mostly cylindrical, rarely flattened, and usually hollow, being only solid at the nodes. The leaves consist of a sheath, ligule, and blade. The sheaths encircle the stem with the margins free—*i.e.*, the sheaths are open. At the junction of the sheath and the leaf-blade is usually the ligule—a small outgrowth, the presence or absence of which is an important point in the determination of grasses from vegetative characters alone. It may be membranous or reduced to a fringe of hairs. The blades are usually long and narrow. The flowers are mostly hermaphrodite, although sometimes, as in the maize, are unisexual. They are mostly small and inconspicuous and consist of stamens and pistil, and of two or three minute transparent or sometimes fleshy scales called the lodicules, which are supposed to represent a reduced perianth, placed between two or three bracts, the outer ones now called the lemmas, although in older descriptions they were usually referred to as the flowering glumes, and the inner one called the palea, the whole forming a floret or false flower. The florets may be single, or several may be borne together on a slender axis, bearing at the base two empty bracts, called the upper and lower glume respectively. The florets and glumes together form a spikelet. The fruit (technically termed a caryopsis) is usually referred to as grain or "seed" and has a thin pericarp adnate to the seed.

Gramineæ is the family of the greatest economic importance, as it contains the principal grain crops of the world—wheat, rice, barley, rye, &c. The native grasses of Queensland number over 500 different sorts or species and represent very largely the basis of the wealth of the State.

Family Cyperaceæ (The Sedges).

The sedges are very closely related to the grasses, but differ in that the stems are mostly triangular and solid, whereas in the grasses

the stems are hollow except at the nodes. The flowers in sedges are borne in the axil of a single bract, whereas in the grasses they are borne in the axil of two bracts—the lemma and palea respectively. In sedges the leaf-sheaths are closed, whereas in the grasses they are open, or at least the margins are free and not united.

The sedges, on the whole, are not of much economic consequence. They favour rather damp, badly drained situations, and in such places often represent quite a considerable bulk of the fodder available. One or two, such as Nut Grass (*Cyperus rotundus*), are very bad weeds of cultivation.

Family Palmæ (The Palms).

Palmæ is a family of trees, shrubs, or, more rarely, forest climbers. The trunk is simple, very rarely branched. The leaves are alternate, and in the climbing species—*e.g.*, Lawyer Canes or Rattans (*Calamus* spp.) are more or less distantly placed along the upper parts of the stem. In the arborescent ones they are mostly arranged in a large terminal crown, and as they drop off they leave the stem covered with leaf scars. The leaf-blade is either palmately or pinnately divided, and by this distinction palms can readily be divided into two distinct classes—(*a*) the Fan Palms, and (*b*) the Pinnately or Feather-leaved Palms. The inflorescence variously forms a spike raceme or panicle often very large and intricately branched. In the young stage the whole inflorescence is enclosed in a large spathe or the individual branches are enclosed in smaller spathes. The flowers are mostly unisexual, male and female growing on the same tree and mostly in the same inflorescence, though occasionally they may be on different trees, as in the common Date Palm. In a few cases they are hermaphrodite. The flowers are typically 3-merous, as in most of the Monocotyledons, though one or more of the parts may be abortive or missing. The perianth segments are usually cream-coloured and of a rather thick, leathery nature. The carpels are three and may be free or united. In most cases only one carpel develops, the other two becoming aborted. The fruit is mainly a 1-seeded berry or drupe.

The Palms number over 1,000 species. They are essentially tropical plants, a few extending to the sub-tropics and a very few to more temperate regions—*e.g.*, one in Southern Europe, a few in Korea and Southern Japan, a few in New Zealand, and one in Chile. In Australia by far the greater number of species occurs in North Queensland. Queensland possesses about thirty species, distributed over fifteen genera.

Family Araceæ (The Aroids).

The family *Araceæ* is a family of herbs with a tuberous or elongated, fleshy rhizome, terrestrial, but often rain-forest (scrub or jungle) climbers, clinging to the host tree or to rocks by means of numerous aerial roots. The main character of the family is that the flowers are small and crowded on a spadix enclosed in a spathe. The individual flowers are hermaphrodite or unisexual, the males in the upper part of the spadix, the females in the lower; rarely the males and females are on different plants. A perianth is present in the hermaphrodite, but is absent from the unisexual flower. The fruit is a many-seeded berry.

The family contains some important tropical crops, as the Dasheen and Taro. Some of the species, such as the Arum Lilies, Caladiums, &c., are common in garden culture. The plants contain numerous needles

of calcium oxalate which make them inedible in the raw state (see p. 612 and Plate 260) and only eatable after considerable cooking. A common climber in Queensland gardens and bearing an edible fruit is *Monstera deliciosa*. Several members of the family are found growing wild in Queensland either as terrestrial herbs (*e.g.*, Cunjevoi) or as forest climbers (*e.g.*, species of Pothos and Raphidophora).

Family Bromeliaceæ (The Bromeliads or Pineapple Family).

Bromeliaceæ is a family of tropical American plants, herbs, or epiphytes growing on trees and rocks. The leaves are usually long and crowded at the base of the plant. The flowers are borne in a terminal inflorescence and are often very showy and accompanied by numerous coloured bracts. The perianth is usually distinctly marked off into a calyx and corolla. The stamens are mostly six in number, and the ovary is inferior. The fruit is a fleshy berry or dry capsule and is crowned by the persistent calyx. In one genus (*Ananas*, the Pineapple) the rhachis of the inflorescence, the bracts, and fruits are all welded together, as the fruit ripens, into a fleshy mass producing a large succulent syncarp. The rhachis further develops beyond the inflorescence or "fruit" to develop an apical crown of leaves.

The species are all natives of tropical America, and several are cultivated in Queensland gardens as ornamental plants. The most important economically is *Ananas sativa*, the Pineapple. The leaves of the Pineapple and some other members yield an excellent fibre. On the inner face at the base of the leaves peculiar absorptive hairs are developed which enable Bromeliads to utilise water and plant foods in solution, which are held in the dipper-like base formed by the enclosing leaf-sheaths. This is the reason for applying fertilizer to the base of the leaves of pineapple plants as well as, or instead of, to the soil.

Family Liliaceæ (The Lilies).

The *Liliaceæ* or Lily family is a family of mostly herbaceous plants commonly with a bulbous or rhizomatous base, sometimes climbers, rarely arborescent. The leaves are variously shaped; in the arborescent species they are mostly crowded at the ends of the trunk or branches. The flowers are hermaphrodite and typically 3-merous. The ovary is superior. The fruit is either an indehiscent berry or a capsule opening in three valves.

Liliaceæ is a very large family distributed over both the temperate and tropical regions of the world. Some of the species are used as culinary vegetables, as the Onion (*Allium Cepa*); some in medicine, as the Sarsparilla (*Smilax officinalis*), the Squill (*Urginea scilla*), and the common aloe (*Aloe vulgaris*); some for fibre, as the Sisal Hemp (*Agave sisalana*) and the New Zealand Flax (*Phormium tenax*). Large numbers, as Lilies, Tulips, Hyacinth, &c., are cultivated as ornamental plants. The family is well represented in Australia.

Family Amaryllidaceæ (The Amaryllids).

As understood by most authors, this family is only separated from the true Lilies on the very slender distinction of the ovary and fruit being superior in *Liliaceæ* and inferior in *Amaryllidaceæ*. Hutchinson, in his recent work (already quoted), has removed a number of the *Liliaceæ* into the *Amaryllidaceæ*, and has taken as the main character of the family an umbellate inflorescence subtended by an involucre of two or more bracts.

The family is frequent in garden culture, containing the very showy species and hybrids of *Hippeastrum* (generally known in cultivation as Amaryllis) and other plants. The family is not numerically strong in Australia, the largest genus being *Crinum*, of which several species are recognised as native.

FAMILY MUSACEÆ (THE BANANAS).

In the earlier systems the family *Musaceæ* contained several other genera than Musa (the Bananas proper). Hutchinson, in his most recent treatment, confines the family to the Bananas, excluding the Strelitzias, Travellers' Tree (*Ravenala*) and others. The members of the genus Musa are treelike herbs, the stem or trunk formed by the spirally arranged persistent leaf-bases. The leaf-blade is large, with a strong midrib and numerous parallel veins arranged at right angles to it. The flowers are mostly unisexual and borne in a long, upright or pendulous terminal inflorescence. The female or fruit-bearing flowers are borne in the lower, the male or sterile flowers in the upper or apical, part of the inflorescence. The flowers are in groups of five or more subtended by large, usually reddish-purple bracts. The perianth is divided into a distinct calyx and corolla. The calyx is spathaceous, open on the inner side and toothed at the apex. The corolla is mostly smaller than the calyx and two-lipped. The stamens are five, with or without an additional smaller rudimentary one. The ovary is inferior and 3-celled. The fruit is fleshy and indehiscent. The seeds (not present in the edible cultivated ones) possess a hard testa or seed coat.

The Bananas number approximately forty-five species widely spread over the tropical and subtropical regions of the world. Three species are indigenous in North Queensland.

FAMILY ZINGIBERACEÆ (GINGER FAMILY).

The members of the family *Zingiberaceæ* are perennial herbs generally with an underground rhizome. The leaves consist of a lower portion (the sheath) and an expanded portion (the blade). At the top of the sheath and base of the blade there is usually a small outgrowth—the ligule. The inflorescence may be terminal on the leaf-shoots or borne on a separate stem. The perianth is distinctly marked off into calyx and corolla. The calyx is usually tubular or spathaceous (*i.e.*, splitting open on one side), and is variously toothed at the apex. The corolla is united in the lower part, but split into three parts (lobes) in the upper. Only one perfect stamen is developed, the other two being united to form the labellum, which is usually petal-like, and the showiest part of the flower. The ovary is inferior, and the fruit is either capsular or more berry-like and indehiscent; the seeds are numerous.

The family is a tropical one, finding its greatest development in the Indo-Malayan region. Several species (Wild Gingers) are found in the forests of coastal Queensland. The most important economic species is the Ginger (*Zingiber officinale*).

FAMILY CANNACEÆ (THE CANNAS).

The Cannas are plants of similar habit to the Gingers, but the leaves do not possess a ligule at the junction of sheath and blade. The flowers are showy and are borne in a terminal inflorescence. The perianth is divided into a distinct calyx and corolla; the calyx consists of three sepals, and the corolla of three usually long, narrow petals.

The stamens are six in number, usually only one perfect, the others modified into showy petal-like structures, representing the showy part of the flower of the numerous cultivated forms. The ovary is superior, the fruit a dry capsule, the seeds numerous and round.

The family consists of a single genus containing several species, natives of tropical America. The limits of the natural species are not well defined. The numerous cultivated varieties are the result of hybridisation. *Canna edulis* is cultivated in tropical and subtropical countries on account of the starch content of its large tubers. It is known within Australia and abroad as Queensland Arrowroot.

Family Orchidaceæ (The Orchids).

The Orchids constitute a very large family of plants, terrestrial (growing in soil) and epiphytic (growing on trees or rocks), or growing among decaying vegetable matter. Most of the terrestrial ones are tuberous, the tubers being mostly borne in pairs. In the epiphytic orchids the stems are mainly creeping, the creeping part being known as the rhizome. The ascending stems may be swollen, and are then referred to as pseudo-bulbs, from the Greek *pseudos* (false) and *bulbos* (a bulb). The roots of epiphytic orchids serve not only as a means of obtaining nourishment, but a means of attachment. In some cases they contain chlorophyll—the green colouring matter of plants—and probably perform in part the functions of leaves. The roots of most epiphytic orchids are enclosed in a spongy sheath termed the velamen (Latin, meaning a covering). It is the velamen which gives the white, corky appearance to orchid roots, especially when dried. It is a many-layered, spongy tissue whose function is to suck up rapidly and afterwards hold moisture, to be drawn upon by the plant as required. In some extreme cases, such as two peculiar subterranean orchids—one of which was recently found in Western Australia, and the other in New South Wales—roots may be entirely absent. The leaves are extremely variable, sometimes being totally absent, and only represented by a few scales on the flowering stem, as in the common *Dipodium punctatum*, the Spotted or Hyacinth Orchid. In one case—*Taeniophyllum*—there are no leaves of any sort—not even scale leaves; and in this case the roots are green-coloured and probably perform in part the functions of the leaves. The flowers are variously arranged; they may be solitary or in pairs in the leaf axils, in racemes or spikes, in heads or in branched panicles. The perianth consists of six segments in two series. The three outer members of the perianth are generally referred to as the sepals. The back sepal is referred to as the dorsal sepal, and the side ones are known as the lateral sepals. They may be all very much alike, or the dorsal sepal may be markedly different from the lateral ones. The three inner members of the perianth are the petals, and a feature of practically all orchids is that the lowermost one is very much modified in some way. It is generally lobed and differently coloured from other parts of the flower, and is called the labellum. The one exception to this rule among Queensland orchids is the genus *Thelymitra*, which contains the Sun Orchids. It is to the labellum that the distinctive beauty of some orchids is due, and this member is an extremely important one in orchid classification, particularly in the differentiation of species. The principal distinguishing feature of orchid flowers is that the stamens, the style, and the stigma are united into one body, usually referred to as the column. The stamen is generally regarded as being represented in all

cases of Australian orchids by a single fertile anther, borne at the top of the column. The pollen is mostly somewhat waxy, and is usually arranged in two to eight small globose, egg-shaped or club-shaped pollinia or pollen masses, which may be extended at one end into a straplike body called the caudicle. The stigmas are situated just below the anther. They are three distinct (in *Cypripedium* or Slipper Orchids) or usually only one (supposed to be two consolidated). In this latter case the upper border is usually, though not always, developed into a small body called the rostellum—a hinged or easily detachable organ supposed to represent a sterile or abortive stigma. The column is variously shaped, lobed or winged; it may or may not be developed into a foot at the base, and has an important place in orchid classification. The ovary is inferior—that is, below the perianth segments and stamens, which are situated above it. The ovary eventually develops into a seed capsule, the seeds themselves being minute and borne in great abundance.

Though commonly associated with hot, humid tropical regions, it may be mentioned that the members of this family are not confined to the tropics and sub-tropics of the world, but are moderately common in England, continental Europe, and the temperate parts of the Southern Hemisphere. The orchids of the British Isles number approximately forty distinct species or kinds, and when we come to countries such as France, larger and with a more diversified climate, the number of orchid species goes up to seventy-five or eighty. The family is, of course, a huge one, and contains more species or different kinds than any other family of flowering plants, the number of described species being somewhere about 20,000. The greatest number are found in countries such as New Guinea, Burma, Sumatra, the Malay States, and allied countries. Some of the more showy sorts come from the Upper Amazonian and Central American region, but more numerous kinds are known from the tropics of the old world.

[TO BE CONTINUED.]

COPPER STAND AND CLOTHES DRAINER.

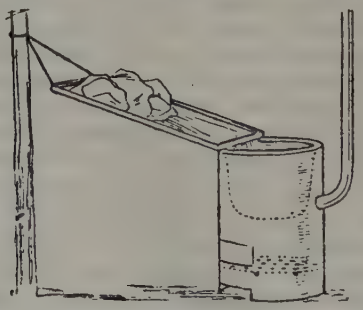


Plate 319.

Take a 40-gallon petrol drum and cut a hole in the top to fit your copper tightly under the ledge, about 3 inches in from the edge of the drum for a 10-gallon copper. About 12 inches up from the bottom of the drum cut a doorway 12 inches wide by 9 inches high. Underneath this, right at the bottom of the drum, cut out a piece 12 inches by 4 inches, for removing the ashes. Next procure an old lid of another drum and punch a number of holes in it like a grate. Then take two very long bolts and put these through the copper stand about 1½ feet apart, about 1 inch under the bottom of the doorway. Place your grate on these bolts and cut a small circle at the back of the drum just above the grate. Rivet on a piece of piping for the chimney and your stand is complete. The drainer is just a long piece of tin with the sides turned up and blunted and which is tied with wire to a post.

Animal Health—The Aim of Veterinary Science.

Professor H. R. SEDDON, D.V.Sc., Dean of the Faculty of Veterinary Science, University of Queensland, and Veterinary Adviser, Department of Agriculture and Stock.*

WITH the establishment of the Veterinary School in the University of Queensland, and the provision of veterinary education in this State, it would seem appropriate to set forth the aims of veterinary science and indicate the scope of the work to be undertaken by our graduates.

IMPORTANCE OF THE ANIMAL INDUSTRIES.

This audience perhaps needs no reminder of the importance of animal production in Queensland, and the effect that successful animal production has on the well-being of the State.

All our foodstuffs of animal origin, with the exception of fish, infant foods, and a few prepared delicacies, come from animals fed and husbanded within the State; and, with the exception of those cattle brought from the Northern Territory, bred and raised entirely within the State. Not only all the beef, mutton, pork, and poultry we eat, but all our supplies of edible animal products such as milk, butter, cheese, and eggs come from our own stock.

There is, therefore, a very considerable animal population, necessary not only to supply our own food requirements, but to some extent those of other States of the Commonwealth. Moreover, it furnishes a surplus for exportation overseas.

Of all the Australian States, Queensland is more dependent upon the livestock industries than any other, our animal production during 1934-35 representing 37·4 per cent. of our total production, whilst in New South Wales it was 28 per cent., Victoria 27 per cent., South Australia 20 per cent., Western Australia 21 per cent., and Tasmania 22 per cent.

The total gross value from animal production in Queensland in 1934-35 amounted to some 20½ million pounds, and of this the value of exports of beef, wool, butter, and so on, was 17 millions. Hence we exported about 83 per cent. of the fruits of our pastoral and dairying industries.

To express our animal wealth in another way, we may recall that the State of Queensland contains nearly half the cattle, a fifth of the sheep, a fourth of the pigs, and a fourth of the horses in Australia, whilst our poultry industry, though still smaller than that in four of the other States, is expanding.

In a very informative article on the subject of the "Empty Spaces" in Australia, and the possibilities of extending occupation and increasing agricultural and pastoral production, the Bank of New South Wales, in its circular for August of this year, points out that opinions may vary as to what area of Australia may be considered as "desert." The writer of this article suggests that in considering the availability of land for settlement we may regard as desert that part of our continent lying

* Address delivered at the official inauguration of the Faculty of Veterinary Science within the University of Queensland, at Brisbane, on 29th October, 1936.

within the 10 inch line of rainfall in the southern part and the 15 inch line in the North (the latter owing to the greater evaporation). That this "desert" area of one and a quarter million square miles is not at present utilised to any great extent is evidenced by the fact that it carries less than 6 per cent. of the sheep population (mainly in Western Australia), and 6 per cent. of the cattle (mainly in Queensland). This "desert" area comprises over one-third of Australia, and, though at present it may not be stocked to capacity, inasmuch as improved water supplies would enable it to carry more, the facts indicate that it is not likely to carry any large proportion of the stock in Australia. If one accepts this area as "desert," the available area of Australia for effective occupation is only some 1,724,600 square miles instead of the actual total area of 2,924,600 square miles.

Particularly important to us in Queensland is that one and three-quarter million square miles of country has been deemed potentially suitable for settlement, for an examination of its distribution shows that nearly one-third (540,000 square miles to be exact) lies within this State.

Whilst opinion may differ as to the real value of much of this country, and even if we allow for factors such as soil fertility and market accessibility—both of which have an important bearing on potential animal production, and which, with other features are in favour of States wholly within temperate climes—it still remains that Queensland seems destined to contribute to the live-stock wealth of Australia an even greater share than it does to-day.

IMPORTANCE OF ANIMAL HEALTH.

Whilst our wealth in numbers of animals is very considerable indeed, the real value of these to the community depends upon the use we can make of them, and the gain to us from their exploitation. It is of prime importance, therefore, that we should get:—

(*a*) The maximum production from the living animal, whether it be in the form of work, or such products as wool, milk, or eggs; and

(*b*) the maximum return from the dead animal, whether it be in the form of beef, mutton, pork, hides, skins, etc.

Anything, therefore, which prevents or lessens our obtaining the full return is a form of wastage and to be obviated if possible.

Important in this regard is animal health, for, using the late Sir Arnold Theiler's definition, health "is that condition of an animal which is most suitable for maximum economic exploitation." To him "the non-productive animal is apparently unhealthy, or better, a diseased animal." Though written only seven years ago, so rapid has been the increase in knowledge that the truth of this is now even more readily apparent, quite recent studies, particularly in nutrition and genetics, showing us that many not obviously diseased animals are in reality so.

RELATION OF HUMAN AND ANIMAL HEALTH.

Animal health is of importance, however, in another direction, and this because there are certain diseases of animals communicable to man. (Parenthetically it may be mentioned that there are also certain diseases of man transmissible to the lower animals.) As examples of animal

diseases which also affect man, we may mention Tuberculosis, Anthrax, and Hydatids. The seriousness of these varies. Though the degree to which man in Australia suffers from them may not be as great as in certain other countries, these diseases, nevertheless, exact a toll on human life and human efficiency, in spite of such measures of control as are in operation at the present time to safeguard human health from attack by them. Anything that we can do—and there are certainly additional measures which could be adopted—will therefore not only lessen animal, but human, wastage.

ANIMALS COMPANIONS TO MAN.

There is still another way in which animals concern us, a phase of animal life which, however, does not bear on our economic needs. I refer to animals as companions of man. Dogs, cats, and birds are commonly kept as companions and pets, affording us comfort and mental happiness which cannot be expressed in monetary terms, but which none the less are of very real value indeed.

Certainly, a proportion of our dog population is maintained solely that these animals may be of service to us for guarding our possessions, or to assist us in droving animals fleeter of foot than ourselves. A further proportion is kept for racing purposes, affording devotees of the sport enjoyment and opportunity for speculation. But a very large proportion of our dogs are not kept for utilitarian or amusement purposes, and, though we have been warned by Kipling against "giving our heart to a dog to tear," it still remains that dogs are valued for their companionship alone. I, being a man, cannot pretend to understand the sentimental value of cats. As there are 24,000 registered dogs in the city of Brisbane, there are probably, in Brisbane alone, 100,000 owners who derive pleasure and comfort from having one, of not more, cats about the place.

Even in this age of motoring, one finds evidence in all States of the pleasure men and women derive from riding, and not only those who rode in pre-motoring days, but those of later generations as well. Few can afford to keep a horse and derive that infinite pleasure which is to be gained by the true horse-lover, but, so popular has riding become in recent years, that it would really seem that, contrary to what has been said of Australians, they do love a horse and derive pleasure from being on horseback.

HOW TO SAFEGUARD ANIMAL HEALTH.

For many reasons, therefore, animal health should be safeguarded. The question is how to do it.

The dog was probably the first animal domesticated by man, and was used by our early ancestors for assistance in hunting, or for guarding food from the depredations of wild animals. Apart from any sentimental reason, therefore—though this doubtless operated at times—he had a material interest in endeavouring, should his dog be wounded or become ill, to restore it to health. Later, as he domesticated other animals, he doubtless cared for them in sickness for much the same reason as we do to-day, for he, like us, was dependent on them for transport, for food, and for raiment.

Through all the ages man has endeavoured to increase his knowledge of animal complaints, but one need not attempt here to trace the developments in veterinary learning. Suffice it to say that the healing art as

applied to animals was referred to in Babylonian writings of some 4,000 years ago; that, as with other sciences, knowledge has waxed and waned, to wax again; but that since the founding of the first veterinary school, in France in 1760, and the setting up of the first in England in 1791, others have been established, in country after country, and there has been a steady acquiring of knowledge, with increase in practitioners of veterinary science, and a recognition by the community that there is a real need for the veterinarian. The veterinarian, too, has come to realise that much more is required from him than the treatment of the sick or injured; that his real province is to safeguard stock from disease, to endeavour to maintain health and to assist stockowners in securing the best from their flocks and herds, whether they be cattle, sheep, pigs, or fowls.

WHENCE COMES KNOWLEDGE OF ANIMAL HEALTH?

Before we can practise measures designed to promote and maintain animal health, we must gather a knowledge of how ill-health comes about, that is, its causation, and the remedies, both preventive and curative, which may be adopted. This knowledge is not to be sought solely in one place, and there are three classes of persons, by whose united efforts knowledge of animal health is best obtained. I refer to the stockowner, the veterinarian working in the field, and the veterinarian working in the laboratory.

Nature guards her secrets jealously, and what we suspect to be true has to be tested and proved. Field observation and experience must be checked by carefully controlled experiment, and the discoveries of the laboratory must be tested out under field conditions.

Sometimes the clue to the solution of some problem comes from field observation; at other times from some purely laboratory experiment. But, to complete our knowledge we must reconcile the so-called theoretical with the so-called practical, and conversely the so-called practical with the so-called theoretical.

Now, the building up of knowledge is a long, often tedious struggle, but all who contribute to its acquisition are aided by the stimulus so helpful to the true seeker after truth—service for benefit of mankind. These contributors do not work independently, striving for their own sake to ascertain new facts; they place them in the common pool of knowledge, to which flow all the streams of effort, not only those I have mentioned, but those from workers in other spheres as well. Thus are gathered together the efforts of all observers, of all scientists. Truly a community of effort, in which the chemist, the biologist, the physiologist, the physicist, the geologist—in fact, the exponents of all the -ologies (and even those sciences and arts, which, though not called -ologies, contribute in any way to knowledge of life, and the influences which go to maintain it—all, I say, combine to wage war on those factors which cause ill-health in stock.

How appropriate, therefore, that the knowledge we call veterinary science should have its intellectual home in a University.

THE APPLICATION OF KNOWLEDGE OF ANIMAL HEALTH.

But the mere acquisition of knowledge is but a means to an end. If it is to be worth anything, it must be put into practice. As knowledge is acquired so must it be dispersed. A cycle is instituted, for, in the dispersal of knowledge, experience adds to it in snowball fashion.

And as the various sciences contribute to knowledge, so do the exponents of the various sciences contribute to the education of the veterinary graduate, in order that these young men, and women, may go out as disciples, preaching and practising animal health. In this way, the University lecturers in the sciences I have mentioned contribute to the end we have in view, for, whether they actually realise it or not, it frequently happens that the wisdom they propound reaches not only the ears of their students, but later—though possibly not in the same form—the ears of the stockowners.

ORGANISATION OF VETERINARY SCIENCE.

It may not be out of place here to indicate the requirements of a community for the safeguarding of animal health. They may be summarised as follows:—

First, a centre for the training of veterinary graduates.

Second, a state organisation to direct the activities of those engaged on the public behalf in combating ill-health in all its forms.

Third, a number of veterinarians working independently as private practitioners, or engaged by other than State organisations, treating the sick, and advising stockowners in order that such animal health as cannot be said to be of national importance may be adequately cared for.

Moreover, that the best results may be attained it is necessary that these three work in unison, and particularly important is it that there should be the closest liaison between the teaching centre, the research centre, and the extension service.

Let us see what has been done in Queensland to fulfil these requirements.

Owing to the generous provision of the Queensland Government, this University has been able to create a Faculty of Veterinary Science, and is providing that Faculty with the staff, accommodation, and equipment necessary for the instruction of its students; that is, the centre for training which has now been inaugurated.

The State is also alive to the necessity for building up an organisation commensurate with the need for developing veterinary knowledge, and for applying that knowledge. Thus, it is extending and building up those facilities for research, for diagnosis, for administrative control of disease, and for the education of the stockowner, and the furnishing to him of assistance in animal health problems. Moreover the necessary co-operation between the school and the Department of Agriculture and Stock has been provided for.

That those not in State employment should have legal protection for their calling, similar to that afforded the other professions, and that stockowners should be protected againt inexpert and unskilled persons, from quacks and charlatans, the Government to-day introduced in Parliament a Veterinary Surgeons Bill. Whilst the passage of that Bill will safeguard the interests of the qualified veterinarian, that very safeguard will be a protection to the stockowner.

It is far from inappropriate that the State should show such sympathy with, and devote such financial help to, the live stock interests, for it should be realised that the well-being of those interests is not simply a matter which affects stockowners; it is the concern of every member of the community.

Although, perhaps not unnaturally, the bulk of the cost of institutions for research, for teaching, and for the dissemination of information falls on the State, recent events have shown us that very substantial contributions have come from other sources. One refers to such activities as those of the Queensland cattle growers (who have so handsomely contributed, by the stock levy, for researches into Queensland problems); the Australian Dairy Cattle Research Association (which has, with the assistance of the Commonwealth Bank Board and certain other public bodies, made possible extended investigations into Contagious Abortion and Mammitis); the McGarvie Institute (which for several years has expended several hundred pounds annually on research and given scholarships for students, thus providing future officers for the New South Wales Department of Agriculture); the Pasture Protection Boards of New South Wales (which, for several years, have contributed approximately £1,000 annually for research, and another £1,000 annually to the Sydney University Veterinary School); and the Pastoral Research Trust (which arranged the establishment of a fund of some £40,000 for research, and following the efforts of which has come about the Wool Levy for propaganda and research). Private benefactions may not have been many, but are very substantial, and one records the gift of £20,000 by Sir Frederick McMaster, which made possible the establishment by the Council for Scientific and Industrial Research of the McMaster Animal Health Laboratory in Sydney; (and here I may mention that the "John Thomson Lecture" next year is to be given by the officer in charge of that institution, Dr. Clunies Ross); then there is the Garland Estate, which will assist in veterinary and agricultural education in New South Wales; and the more recent Burdekin bequest (reported in Brisbane papers of 22nd September, 1936) of £41,993, which is to be allowed to accumulate to £50,000, when the interest is to be devoted to research into pastoral problems, probably in New South Wales, as the late Mr. Burdekin was a grazier in that State.

In addition, certain organised bodies of stockowners have recently undertaken to supply a veterinary service to their members, and so amplify the extension work carried out gratis by the various State Departments of Agriculture. I refer to the Veterinary Club established by the Graziers' Co-operative Shearing Company, in Sydney, and the more recent appointment by the Graziers' Association of Victoria of their own veterinary adviser.

One may point out here, that whilst all these are designed to benefit the animal health side of the pastoral industry, those other animals, city horses, dogs, and cats, have not been entirely neglected, for two of three veterinary hospitals to be referred to later are supported entirely by public subscription.

Thus we see that within post-war times the consciousness of the necessity for direct contribution by groups of owners for research, education, and extension work, either in connection with some Government or University institution, or independently, has been aroused. Moreover, the feelings of certain owners have been so stirred, either by what they have received from the pastoral industry, or from a realisation of the need for spontaneous individual help, that they have given freely during their lifetime or made provision for a substantial bequest from their estates.

VETERINARY SERVICES AND THEIR ACHIEVEMENTS.

We may, I think, dwell for a few moments on past achievements, and present and future aims, in the field of veterinary science. New knowledge gained in the laboratory is perhaps the most spectacular—it affords an opportunity for headlines—and its very newness, and the knowledge of the overcoming of some obstacle to progress, excite our imagination; less spectacular is the steady progress made in extension work—there is no sudden turning point as with discovery—and it is only after the lapse of a period that one realises the magnitude and worth of the results which have been obtained.

Some little while ago, Dr. J. R. Mohler, the veterinarian in charge of the Bureau of Animal Industry of the United States of America—which Bureau, incidentally, employs more qualified veterinarians than any other organisation in the world, viz., 3,000—in an address entitled "Fifty Fruitful Years of Veterinary Science"—set forth certain achievements which he felt veterinary science could justly claim. Though recorded as achievements, certain of these are nevertheless still to be regarded as aims, for it cannot be said that the full harvest has yet been reaped.

One may well mention each in turn—with some rearrangement and amplification of Dr. Mohler's claims—for they serve to show the work of the present-day veterinarian, and the service he endeavours to render to the community.

1. Conquest Over Fear of Disease.

In times past live stock have, either individually or in large numbers, been suddenly stricken with disease, bringing disappointment, anguish, and mental worry, to say nothing of considerable financial loss, on the unfortunate owner. These diseases were then mysterious in their onset; their very nature was unknown; they could not be combated; and even the most proficient stockowner and the most able veterinarian of those days were helpless. Since that time the work of investigators has revealed to us the nature of most of these diseases; for a large number of measures of control have been evolved, and, in place of that fear of animal maladies, there has developed a sense of security in the presence of many of these diseases, and a confidence in the ability of veterinary science to furnish aid.

2. Succour of the Sick Animal.

Instead of empirical, we now have relatively exact knowledge, and methods of treatment are based upon rational understanding of the causation of disease; so that, whilst we realise that the great healer is nature, our actions aim to assist her, and certainly do not hinder her.

Our knowledge of drugs is more exact, and we have developed drug treatment for diseases which for generations baffled all efforts. We have seen the use of one drug—carbon tetrachloride—confer a benefit equal to an increase in value of £1 per acre over all land on which sheep may contract liver fluke. How valuable this discovery has been to the live-stock industry may be gathered when I state that, in New South Wales alone, there are hundreds of thousands of acres of land so troubled. We have seen X-rays developed for use on animal patients, and veterinary surgery advanced to a high plane indeed, the instruments and technique employed being the same as for the human patient.

3. Combating of Animal Plagues.

Whilst our knowledge is still far from perfect, we can, and do, prevent the entrance of animal plagues into a country. Certainly we cannot always prevent them, and this for much the same reason that the police cannot prevent all crime. We prevent also their spread through a country, thus guarding against the extensive mortalities which have, through the ages, followed the uncontrolled dispersal of animals. Certain diseases have been eradicated from large tracts of land, even from states and countries; and the future will, without doubt, lessen the geographical distribution of many diseases, and bring about complete eradication of not a few—at least in those countries which possess an efficient veterinary service.

Reference to achievements in some other countries, as well as in Australia, may not be inappropriate.

Glanders, at one time a common disease of horses in Great Britain, has been eradicated from that country; so has Rabies or "mad dog" disease. Both are diseases which affect man. Cattle Plague has been banished from most countries in Europe. It accidentally gained entrance to Western Australia in 1923, but, by the adoption of stringent measures for its control, at a total cost of between £50,000 and £60,000, we were spared the spread of a plague which in the eighteenth century in Germany alone caused the loss of 30,000,000 cattle, and less than forty years ago caused the death of 80 per cent. of all cattle in South Africa.

Contagious pleuro-pneumonia has been eradicated from Victoria, and in New South Wales is well under control. It is, in fact, enzootic (that is to say, it occurs) only in dairy herds round Sydney, and doubtless will in the early future be eradicated from these. Unfortunately for New South Wales, this disease exists in Queensland, and, as some 150,000 to 200,000 cattle go from Queensland to New South Wales every year, and it is not possible by mere inspection to detect carriers, the disease gains entrance to New South Wales from time to time.

Thanks to recent researches it is now possible to apply to cattle a test which will detect these carriers, but it is a test requiring special laboratory facilities. This test has been quite successfully employed for picking out carriers of contagious pleuro-pneumonia in a herd, and so freeing that herd of the disease. The application of this test to all cattle entering New South Wales has been seriously considered. It would be a huge undertaking, and the authorities there feel that the cost would be too great. This does not mean, however, that the test will not be availed of at some future date. (The difficulties I may say are not so much with the test, as with holding the animals at the border for the period required to test them.)

Stockowners in Tasmania are no longer harassed by losses from Black disease, for, following the researches of Australian workers, vaccination has afforded a means of preventing it. The extent to which vaccination is relied upon in that State may be gauged, when it is stated that during the year 1933-34, 125,000 sheep were so treated, all vaccination being done voluntarily by stockowners because they realised its economic worth, and not because of any governmental requirement.

Anthrax was once so rife in New South Wales that it occasioned considerable annual loss. To overcome it, vaccination of millions of sheep and hundreds of thousands of cattle was carried out annually; as a result,

losses from that disease have steadily declined, so much so that only about a score of properties suffer annually, and the losses of sheep and cattle in any one year probably do not exceed 200 head.

Due to the energetic measures taken against cattle tick in the United States of America during the past twenty-nine years, the number of counties quarantined has been reduced from 985 to 71, and the cattle tick now exists in only three States, over 800,000 square miles of previously-infested country (an area one and a-half times that of Queensland) having been cleansed.

In the United States tuberculosis in cattle and pigs is being eradicated, and the magnitude of the work entailed may be gathered when we realise that 130,000,000 tuberculin tests have been applied, 3,500,000 herds have been declared free of the disease, and of a total cattle population of 65,000,000, 43,000,000 (seven times as many cattle as there are in the whole of Queensland) are under supervision for the control of the disease. The aim, as expressed officially, is not simply the elimination of the disease from certain dairy herds (as is so often the case with tuberculin testing), but complete eradication of bovine tuberculosis from that country.

In Canada, one-fourth of the total cattle population is under test for the same disease, which is being eradicated not only from individual herds, but from whole areas of country.

This may well be contrasted with the position in Australia, where we find the following:—

New South Wales: Four country towns have a tubercle-free milk supply; and some 62 herds, totalling 4,448 animals, are officially accredited as tubercle-free. (Of these 4,448, 1,890 are Government-owned animals.)

Victoria: Eight herds, with a total of 1,073 cattle, have been accredited as tubercle-free, but in the case of no town is the milk supply wholly from tubercle-free animals.

Tasmania: The whole of the dairy herds supplying Launceston have been under test for some years. The majority are now tubercle-free, and that town may be expected, in the near future, to have a tubercle-free milk supply.

Queensland: A number of dairy farmers have had their herds tested, but again only a very small number of owners are attempting to banish tuberculosis from their herds. Only one dairy in Queensland has so far complied with the requirements set down for a fully-certified dairy —that is a herd free not only from tuberculosis, but from certain other diseases, and producing milk conforming with a certain standard.

Other States: I have no definite knowledge, but the position is, I think, much the same.

Canberra, however, has a tubercle-free milk supply.

Contagious abortion and contagious mastitis, both serious diseases, present in Australia and causing considerable wastage in our dairy industry, are being dealt with in the United States of America by a disease control programme similar to that for tuberculosis.

One could go on and mention many more similar examples, both here and abroad, but sufficient has been said to establish the point that animal plagues are being combated.

4. Contribution to Human Health.

Such control is now exercised over many diseases communicable to man that, at least in civilised countries, many of these diseases no longer menace human health. Veterinary meat inspection, such as we have for the City of Brisbane, removes from us the danger of disease spread by animal foodstuffs, and assures to us the supply of wholesome meat.

In other countries veterinary meat inspection is being utilised to a much greater extent than in Australia. In New Zealand every town of over 5,000 inhabitants has its municipal abattoir, and the inspector, if not a fully-trained veterinarian, works under veterinary supervision.

In several European countries every town of over 2,000 inhabitants has a public abattoir, and veterinary inspection is obligatory; in the other countries the smaller towns are not so well served, but the same system obtains. A similar state of affairs exists in certain American countries, for instance, the United States, Canada, and Brazil.

Having in view the position in most civilised countries, one can readily see how considerable improvement could be effected in Australia.

Considerable effort is made in certain countries to avoid danger to human health from diseases which might be contracted through milk. The most important of these diseases is tuberculosis, but, though control of tuberculosis in cattle is being undertaken in many countries, such is being done primarily because of the loss the disease causes the cattle and pig industries, and not for the influence on human health. That this influence is by no means negligible, however, is evidenced by the fact that already the improvement in the United States of America and Canada is reflected in lessened incidence of tuberculosis in infants.

5. Improvement in Economic Stability.

For economic stability of a country such as ours there must be regular animal production, regular supplies of animal products, and stabilised markets. The control of marketing is not the province of the veterinarian, but as stability of market depends very largely upon regularity of supplies, and these again on the absence of influences calculated to upset regular supply, the veterinarian is not without some responsibility. Extensive disease epizootics (that is, animal plagues), may upset, for one or for several years, the nation's food supplies or its animal exports, and the control of disease, by preventing such occurrences, favours economic stability.

One hesitates to think what would have been the effect on Australia's wool industry had sheep scab not been eradicated. One has only to recall the toll exacted on the cattle industry as tick fever spread through Queensland, causing, it is estimated, the deaths of 2,000,000 cattle between the years 1894 and 1900. To this may well be added the heavy annual toll since that date from mortality, from cost of vaccination, from cost of dipping, from restrictions on stock movements, and from inability to utilise ticky areas for non-immune stock.

Recently, however, it has been shown to be possible to take cattle from a non-ticky area and to depasture them with safety in some of our worst tick-infested country, a thoroughly sound and safe means of immunisation against the three types of tick fever in this State having been evolved.

With eradication of disease much freer movement of stock is possible. There is no need to vaccinate; no need for quarantine, and no need for inspections to check the spread of disease by cattle movement. During recent years the United States of America has suffered considerably from drought, but, thanks to its policy of tick eradication, areas from which cattle tick had been eradicated provided relief country for over 1,000,000 cattle in one year alone.

Ability to control fluke, and stomach and bowel worms, has placed sheep production on a much more stable basis, enabling it to be carried out in localities which a few years ago were regarded as "unsound."

The excellent control now exercised over anthrax in Australia has placed this country in a very fortunate position in connection with the hides industry. As it is possible for hides from Australia to be certified free of anthrax, they are not, like hides from many other countries, subject to trade embargoes, nor is it necessary to sterilise them before using them for trade purposes. Australian hides, therefore, have a free market, and the tanning industry is materially assisted, for to the cost of the raw product it is not necessary to add cost of disinfection.

But ill-health is not always the result of animal plagues. It may be caused by other things than microbes and parasites, and one of the commonest in Australia is faulty nutrition. Sometimes it is a matter of quantity of food, sometimes of quality. Though important investigations have been undertaken on the use of concentrated foods in times of drought or as supplements to natural pasture, much additional investigation is necessary.

We hope to utilise for stock much of our country as yet uncleared or utilised to only a limited extent. Like other countries, we shall have to develop our fattening and dairying areas so that they provide more, better, and more regular supplies of foodstuffs than is possible when we rely on natural pasture alone. We require our pastures to be such that, if possible, we have continuity of adequate foodstuffs. For those parts where this is not possible, we require food supplements at economic prices. This is a matter for team work, and there is considerable scope indeed for the combined efforts of the agriculturalist, the agrostologist, the agronomist, the biochemist, and the veterinarian, in order that this desirable state of affairs may be brought about.

Not only feeding but breeding also is important, and though as yet I have only a limited experience of the cattle industry in this State, I am of opinion that we shall have to exert very considerable effort in this direction also. Our watchword for both feeding and breeding might well be *uniformity,* for in Australia there is, in my opinion, too much *diversity.* We know what standardisation has accomplished for certain industries; can we not feel assured it will do much for the animal industries?

It has been shown that there are considerable areas in Australia where there exists a phosphorus deficiency in the soil, this being reflected in the pasture, so that stock grazed on that pasture do not get the requisite mineral for proper bone formation, and consequently suffer from cripples. It has recently been found, also, that along a large part of the southern border of Australia there exists in sheep a disease which is due to a deficiency of cobalt. As these deficiencies very definitely affect the soundness of the country for stock, their elimination by the provision of preventive and curative licks will be of considerable benefit.

Phosphorus deficiency can be combated, but the use of phosphatic supplements is by no means as general as it should be. Practical measures for the overcoming of the cobalt deficiency are in sight, and doubtless ere long economic livestock production will become possible in areas where this deficiency exists.

There are other diseases with a nutritional basis, some purely nutritional, others actually due to some other agent but confined to animals in which some nutritional disturbance is present. Researches, several quite recent, have shown us how some of these diseases may be prevented or cured. And, although in this nutritional work the chemist, particularly the biochemist, has played a marked part, the veterinarian has contributed his share, for, thanks to the basal knowledge provided by the biochemist, the veterinarian has developed lines of treatment so that the dairy farmer is no longer seriously troubled by such complaints as milk fever, grass staggers, and carrion poisoning, nor the grazier by twin-lamb disease.

Unfortunately, we know only too well that there are many other problems awaiting solution, or awaiting an economic means of prevention, and it is in this direction that the efforts of our future graduates will perhaps be most needed, in order that, by the prevention of wastage from ill-health, the stability of the livestock industries may be assured.

6. Humane Treatment of Animals.

I have referred to present-day ability to treat successfully animals which, like ourselves, unfortunately, suffer ill-health. Most of our interest is in the material exploitation of animals for our own gain, but there is another side to our nature. I refer to the humanity of our treatment.

We should not fail to remember that the lower animals are like ourselves—they have feelings, they suffer pain—and surely we, as fellow living beings, have some responsibility in preventing their suffering.

Recently I had the opportunity of seeing three public veterinary hospitals in the South. At one 16,000, at another 8,000, and at the third some 3,000 individual animals are treated each year. Being situated in the city, it is natural that the majority of these animals were dogs and cats. Two of these institutions, in addition, take from the streets some thousands of unwanted dogs and cats and those which have strayed far from home. Often these animals are suffering from disease, and all too often they are starving or show evidence of having been otherwise ill-cared for. Many of these animals are nursed to health and, if possible, owners are found for them.

As the barbarities of early times have passed away and man has become kindlier, it is good to feel that he is being assisted by what various sciences have given us for the relief of animal suffering. Perhaps the most important is the provision of anæsthetics, both general and local, and I may here mention that not only chloroform, ether, and cocaine, but the newer methods and the most recently discovered drugs for producing anæsthesia are commonly used by the present-day trained veterinary surgeon.

It is really remarkable the way in which these different veterinary hospitals have sprung up in Great Britain and in parts of Australia, and wherever they have been established their resources have been

utilised to the utmost. Whilst veterinary surgeons may carry on extensive practices they cannot undertake all the needs of the community, and, particularly for animals belonging to the poorer classes, there is a real need for clinics to which they may take their dumb friends when they are sick or injured. We look forward in Brisbane, therefore, to the clinic to be established at our veterinary school undertaking humane treatment of animals which otherwise would not be brought to those skilled to treat them.

7. Assistance in Industrial Development.

There are two types of industrial undertakings intimately associated with animals. First, there is that type associated with the exploitation of animal products, that is, the fresh, frozen, and chilled meat industries, the butter and cheese industries, the milk industry, and the poultry industry. Whilst this exploitation of animal products is chiefly a matter for the manufacturer or purveyor, we find that, quite apart from what the veterinarian has to do concerning the health of the living animal, he also contributes some assistance to the purely industrial side itself. To exemplify:—It is a prerequisite that all frozen and chilled meat exported from Australia has to be inspected and passed by a veterinary officer of the Commonwealth Government. Again, extensive investigations have been undertaken by the Council for Scientific and Industrial Research to determine the best method of sending chilled meat overseas and combating troubles which are liable to develop in such a product. It is not without interest to note that in the team of workers employed in these investigations there is, in addition to a bacteriologist, a chemist, and a physicist, a veterinarian. Thus does science become the handmaiden of industry.

There is, however, another type of industry associated with animal production. I refer to those industries concerned in the manufacture of licks, special foods, medicines, vaccines, and so forth, for use on stock. Anyone familiar with the products will appreciate the size and importance of these industries. The technical knowledge responsible for many of these products comes from the veterinarian, and certain of these industries exist solely to provide the stockowner with remedies advocated by the veterinarian.

8. Improvement in International Understanding.

Veterinarians as a profession have for some time had an international conscience. I would remind you that in 1863 John Gamgee (an English veterinary surgeon, then a Professor at the Royal Veterinary College in London) issued a circular inviting teachers in the veterinary colleges and practising veterinary surgeons from all parts of Europe to attend a congress in Hamburg to devise means for the control of animal plagues and in particular the spread of contagious diseases from one country to another. That congress was attended by 101 veterinarians, and it marked the inauguration of regular international veterinary congresses which from then to the beginning of the Great War were held every four years. The congress in 1914 was held in the early days of that fateful August, and broke up precipitately as the war clouds foregathered. From then, unfortunately, there was a period of sixteen years until the succeeding veterinary congress in 1930. I well remember the applause that greeted the president when he remarked that he was sure that it was "the earnest desire of every member that

the congress might be able to gather up and reunite more firmly the threads that had been broken sixteen years previously."

At the succeeding congress, in Boston, in 1934, 2,815 members were enrolled, the majority, naturally, being veterinarians resident in the North American continent, but 655 were from overseas. Fifty-seven countries were personally represented, some by very large delegations.

Those attending this, as other veterinary congresses, were not there to secure information for themselves alone, or solely for the benefit of their nations. They were there, as anyone who has read the proceedings would know, to pool their knowledge that mankind at large might benefit.

And that later-day development, the League of Nations, has furthered this betterment of international understanding and co-operation in veterinary matters. In 1924 it set up the International Office of Epizootics in Paris, entrusting to it the duty of undertaking the scientific struggle against diseases of animals. This international office, unlike the international veterinary congress, which is purely a meeting carried out by the goodwill of veterinarians, rests upon even stronger foundations, for all delegates to its meetings attend solely as accredited representatives of their governments.

Though all this be but like a drop in the ocean, it is such actions which tend toward a better understanding between nations and encourage the desire of the peoples of the world to live at peace with one another.

From what has been said it will be gathered that there is indeed wide scope for the veterinarian, and that, while young as a modern-day profession, and with much to do, veterinary scientists can, with some pride, look back at the work of the earlier practitioners—persons who, in spite of the lack of present-day facilities, have achieved much.

If we of to-day are awed by the magnitude of our task we can derive consolation from the fact that our profession, whilst young, is virile, that it will not have to fight the battle alone (for it will have the ready co-operation of all interests concerned), that it will derive assistance from the men of other sciences, and, moreover, that its members have that "will to win" that is so characteristically displayed by Australians on their cricketing and on their battlefields.

INFLUENCE OF THE FACULTY ON SCIENTIFIC RESEARCH.

Thanks to the munificence of the Government of Queensland and largely through the interest and foresight of the Honourable the Minister for Agriculture and Stock, a Faculty of Veterinary Science has been established in this University, in accordance with the recommendations of the committee appointed by the Honourable the Premier. To all those who have contributed to bring it about Queensland owes a debt indeed.

The Faculty, in the words of that report, is to train men to undertake scientific research in animal problems which are specific to Queensland, and the progressive practical elucidation of the problems themselves. Whilst striving to carry out the trust so imposed upon us, we should, I think, take the broadest view of our responsibilities. There

should be no ambiguity as to our objects, which may be set forth briefly as follows:—

Firstly, to provide for students the means of acquiring a full and proper knowledge of veterinary science.

Secondly, to provide a central fount of wisdom and experience in all matters pertaining to animal health—a fount from which not only our graduates, but other veterinarians in Queensland, may draw assistance and inspiration, and to which they may turn for guidance.

Thirdly, to keep in touch with the needs of our stockowners that we may assist them, in whatever way possible, to derive the maximum profit and pleasure from their animals.

The machinery has been created. It is for us to look after it, see that it runs smoothly, and that it accomplishes the purpose for which it was designed.

CURING OF PINEAPPLE-PLANTING MATERIAL.

The stripping of dried or aged leaves from the bases of crowns, slips, or suckers prior to planting is now a fairly general practice on pineapple plantations, and one which is highly commendable for several reasons. However, the need for adequate "curing" or drying out of planting material after stripping is not yet so generally recognised. Curing of planting material is valuable chiefly as a preventive measure against losses from the disease of young pineapple plants, known commonly as base rot. Experimental work has shown that adequate curing is by far the most effective method of attacking this disease; it is infinitely more effective than preplanting treatment with any known fungicidal dip or spray. The reason for this is simple and easily understood. The fungus which causes base rot in young plants is also the causal agent of the disease of pineapple fruits known as soft rot or water blister. This fungus can gain entry to plant or fruit tissues through a freshly-cut or injured surface only. The wounds resulting from the stripping of basal leaves from planting material will quickly heal over by the formation of protective cork tissue if left exposed to the drying influences of sunlight and air for a few days. Once the wounds are covered by a layer of corky tissue, the causal fungus of base rot can no longer gain entry to the stump through them. If, however, planting material is inserted in the ground immediately after stripping or before healing of the wounds has been completed, heavy losses from base rot may result, especially if the soil is wet or rain occurs shortly after planting.

The length of time necessary for proper curing of pineapple planting material varies with the methods adopted and with the type of planting material. For example, soft succulent slips would require a longer curing period than hard woody suckers. If the freshly-trimmed planting material is cured by standing it upside-down in the sun on a special "trimming-ground" a day or so of exposure will usually be enough to harden the injured tissues sufficiently to present entry of the base rot organism. A better plan, however, is to strip the suckers or slips in the field immediately after their removal from the plants, and then place them back on top of the mother plants for curing, where they may be allowed to remain without injury until required for planting. However, in this method a curing period of at least a week of dry weather, and preferably longer, is desirable. Planting material cured on the mother plants does not suffer appreciable injury if held for periods up to two months between picking and planting, owing to the fact that while air circulates freely around it the foliage of the parent plants affords some protection from strong winds and direct sunlight. On the other hand, the vitality of planting material cured upside-down in the sun is likely to be impaired by extremely long drying periods. This loss of vitality is shown by the slowness with which rooting takes place, and the subsequent retarded growth of the plants.

Three-day Sickness of Cattle.

(Ephemeral Fever.)

C. R. MULHEARN, B.V.Sc., Acting Director, Animal Health Station, Oonoonba, Q.

A RATHER unusual disease, in which the main symptoms are a fleeting fever and lameness, made its appearance amongst cattle in Northern Queensland during the first half of this year. The first cases were reported in the vicinity of Burketown, but a large area of country around the base of the Gulf of Carpentaria soon became infected. The disease then rapidly spread from this area until by the end of September outbreaks had occurred at various centres on the east coast extending from the Daintree Valley to Bowen.

As a result of investigations carried out at the Animal Health Station, Oonoonba, and elsewhere it has been ascertained that this disease is very similar to, if not identical with, a disease of cattle known as "three-day sickness" or "ephemeral fever" in other tropical countries.

There is no evidence to indicate that this disease has ever appeared previously in Australia, and it is probable that the infection was recently introduced.

Animals Susceptible.

Bovines appear to be the only animals that contract the disease naturally in the field, for outbreaks have occurred over a wide area of country, and all other species of domestic animals must have been exposed to infection, yet there has not been a single record of a case of this sickness in Queensland in any animal other than a bovine. An attempt was made to transmit the disease experimentally to sheep and goats, but this was unsuccessful, for these animals remained healthy following the inoculation.

Cattle of all breeds appear to be susceptible, for in addition to the European types cases have been recorded in animals showing distinct evidence of the Brahman cross. As a general rule, mature cattle appear to be more susceptible than calves; nevertheless animals under six months of age can become infected and present typical pictures of the sickness.

Cause and Transmission of the Disease.

The cause of the disease is not definitely known, although it has been established that it is of an infectious nature, and typical cases have been produced experimentally by inoculation of blood from a sick into a healthy animal. This would indicate that the causal organism is present in the blood of the sick animal, and suggests that the disease may be transmitted from one animal to another by means of blood-sucking flies or other insects.

A large amount of evidence collected from natural outbreaks in the field would appear to confirm such a theory, for several outbreaks and individual cases of the disease have been reported in which the animal that developed the sickness had never been in contact with any other animals. It is doubtful if the disease can be transmitted purely by contact, for experiments have been carried out in which sick and healthy animals were confined together in small pens and were feeding and drinking from the same containers, yet the healthy animals failed to

contract the disease, although subsequent experiments proved them to be susceptible. Even if the disease is not contagious—that is, it cannot be transmitted purely by contact—there is no doubt that it is highly infectious, for once it becomes introduced on to a property it soon spreads until in many cases a large percentage of the animals become infected in a few weeks.

Symptoms.

Following blood inoculation the period of incubation (i.e., the time from the inoculation until the first symptoms appear) varies from two to five days. The disease is best described as occurring in three stages. These are—

1. A stage in which fever is the prominent symptom. This lasts for about twenty-four hours.
2. A stage in which muscular stiffness and lameness are evident. This usually lasts from one to two days.
3. Recovery. This is the period during which the animal shows signs of improvement but still exhibits symptoms of stiffness, &c., before returning to normal, usually about one day.

As a general rule the disease appears to come on very suddenly in the field, and the animal is well advanced in the stage of fever before the owner realises that it is sick.



Plate 320.
Three Day Sickness.—Experimental Case of Disease. Note General Attitude of the Affected Beast.

The first sign of the sickness is a rise in temperature, and if the animal is closely observed at this stage it will be noticed that it is not quite normal. The temperature continues to rise for a period of from twelve to twenty-four hours, until it reaches a maximum of between 106 deg. and 107 deg. Fahr. By this time the animal is more noticeably ill and it has ceased eating and cudding. However, it usually remains in a standing position, and will walk normally or at most a little sluggishly on being driven. In milch cows there is a marked diminution in the milk supply, and there may even be total suppression.

If running at large the sick animal will usually leave the rest of the herd, seek the shade, and stand with its head and ears drooping. In some cases the respiration becomes slightly accelerated and jerky, but in many animals this is not noticeable. At an early stage of the disease, usually at the first rise of temperature, a discharge is noticed from the eyes. This is of a watery nature and at first is not very obvious, but it becomes more copious as the temperature reaches its maximum, and it then sometimes contains a little pus. The amount of this discharge varies in different animals, and in some it is so pronounced that it runs down and stains the side of the face, whilst in others the tears drop only occasionally from the eyes, and they would not be noticed unless careful observations were made. A discharge from the nose usually appears about the same time as that from the eyes. This is at first watery but soon becomes mucoid and stringy, and it is not unusual at this stage of the disease to see the animal with strings of this mucoid material about 3 to 6 inches long hanging from one or both nostrils. This discharge usually remains clear, but in occasional cases it may become slightly "pussy" or turbid. At the same time saliva drops freely from the mouth, and it may at times become frothy.

All the changes mentioned are noticed on the first day, and they represent the first or fevered stage of the sickness. If the animal is running in the paddock and is not under close observation, this stage may not be noticed. Occasionally, and particularly in young animals, recovery follows after this stage, and the animals return to normal after being sick only one day and without showing signs of muscular stiffness or lameness.

In typical cases the second or rheumatic stage of the disease follows the febrile stage, and is seen at the beginning of the second day. Frequently the temperature on the second morning is down to normal, but it may rise again to about 104 deg. by the afternoon. The animal is usually found lying down when this stage has developed, and even though it may be comparatively wild and resent handling when in normal health, it may make no effort to move when approached. When the animal is lying down the head is often resting round on the side of the ribs, as in cases of milk fever. At this stage it is apparent that the animal is sick, and its general appearance causes alarm to the owner if it is his first experience with this disease. The animal has no desire to rise, and difficulty is usually experienced in forcing it to do so, but when forced to stand there may be some quivering of the muscles and the beast may have difficulty at first in maintaining its upright position. The hindquarters, when affected, sway from side to side before they become steady. The animal may move off after standing for a while, but more often it has to be forced to walk, when pronounced lameness is obvious. This may affect either one, two, three, or all four legs. Usually only one or two legs are affected, and to such an extent that at first the animal appears to be unable to bear any weight on them. When all four legs are affected the gait is very proppy and stilted. On walking there is little flexion of any of the limbs, and the toes are dragged along, leaving a mark on the ground. After walking a little distance the gait becomes better, but there is still obvious lameness. When allowed to stand the legs are usually placed well under the body and the back may be arched, according to the number and position of the legs affected. The beast soon returns to the recumbent position on being left alone.

At this stage of the disease the discharge from the eyes has usually cleared up, although the hair over the side of the face may be still matted. However, in some cases a swelling appears around the eyes and the eyeballs become very prominent, due to abnormal pressure at the back of the eye. The nasal discharge usually remains quite copious, and mucoid strings continually form and extend down from the nose before dropping off.

The general appearance of the animal suggests one of fullness, particularly in the left flank, although this is by no means present to the same degree as in cases of hoven or bloat. In some cases gas has been detected under the skin, and this is most commonly seen behind the shoulders. There may even be a slight swelling in this area.



Plate 321.
THREE DAY SICKNESS.—Another Experimental Case.
Note Discharge from Eyes and Nose.

The consistency of the fæces varies. In some cases constipation is present, whilst in others there may be a foul smelling diarrhœa. However, in the majority of animals under our observation there has been little change from the normal in this respect. If the disease is at all severe, there is usually a total suppression of the milk supply in dairy cows, and all animals will spend most of this day lying down.

On the third day there are usually signs of improvement, and animals may recommence eating and chewing their cud. The temperature is usually back to normal, but stiffness or lameness is still evident in one or more legs. It is sometimes noticed that a limb which was showing obvious lameness on the second day has recovered, whilst one of the

other limbs which was apparently normal previously has developed lameness. The nasal discharge is still present, though now not so obvious. Towards the end of the third day the general condition of the animal is much improved, and usually by the fourth day the animal has almost completely recovered, except that there may still be some stiffness of the limbs. This, however, is not an obvious lameness, and it usually soon disappears. In dairy cows the milk supply tends to increase again about the third or fourth day in uncomplicated cases, and it is usually back to normal at the end of a week.

The changes described are those observed in a typical case of the disease, and it will be seen that the sickness usually extends over a period of three days, hence the name "three-day sickness."

Atypical cases are by no means uncommon, and these may vary considerably. In some the febrile stage may last over a period of several days, followed by recovery without any marked symptoms of lameness, although the animal will do very little walking and spend most of the time lying down. In other cases the animal will go down on the second day and appear to completely lose the power of either the fore or hind limbs; so that all efforts to force it to stand prove futile. This condition may prevail from a week to a fortnight, and is most commonly seen in dairy cows. More often the hind limbs are thus affected, and the animal can partially raise itself on its forelegs.

The appetite returns after one or two days, and the general appearance becomes bright, but the animal may be down for up to a fortnight before it can again stand and bear any weight on its legs. Most of such cases recover, provided they are carefully nursed whilst on the ground, but the milk supply is greatly diminished, and it may or may not return when the cow eventually is able to stand again.

As a general rule, the mortality rate in uncomplicated cases is very low, being at the rate of about one to five cases per 1,000. In those cases where death has occurred there is usually some other complicating factor, such as general poverty, undue and forced exertion, such as in travelling cattle or cows advanced in pregnancy.



Plate 322.

Three Day Sickness.—Another Photograph of same Animal. Note Discharge from Eye and Nose. (Experimental Case.)

Post-mortem Changes.

When death occurs in uncomplicated cases of the disease the post-mortem findings are not very outstanding. There may be an abnormal quantity of air in the tissues under the skin, and generally also some air may be noticed under the covering of the lungs, particularly at the borders. The lining of the wind pipe or trachea and its branches into the lungs may be inflamed and swollen and covered with a clear tenacious mucus similar to the nasal discharge prior to death. Sometimes a straw-coloured fluid is found in the chest cavity, and this fluid may also be present in the sac around the heart. The abomasum or fourth stomach may be slightly inflamed, and there is usually some evidence of recent bleeding from the lining of this organ. The spleen may be slightly enlarged, and the gall bladder is often unduly full of fluid bile. However, there is no outstanding post-mortem change which can be taken as definitely diagnostic of this disease.

Treatment.

Medical treatment in the form of drenching is not recommended in uncomplicated cases of this sickness, particularly so when stiffness of the neck muscles is evident. In such cases the animal is not able to swallow normally, and there is a grave danger of portion of the drench entering the lungs and giving rise to pneumonia. Several cases have come before our notice in which animals have recovered from three-day sickness, but subsequently died of pneumonia as a result of being drenched.

Provided the sick animals are well looked after and are placed in a shaded and protected position so that they will not be knocked about by other animals, and are protected from extreme climatic conditions, an uneventful recovery takes place in a few days. It must be borne in mind that many sick animals cannot travel for water, and those that can are not in a fit state to enter a waterhole to drink; consequently, it is essential that an adequate supply of water should be made available to the animals at all stages of the sickness. Potassium nitrate at the rate of 1 oz. to each 4 gallons should be added to this water when the animals are in the fevered stage of the disease.

When an animal becomes cast and remains down for several days, it should be made comfortable by the provision of an adequate quantity of bedding. It should be turned over from one side to the other at least twice a day. The affected limbs should also be fomented by the application of rugs which have been steeped in hot water and then wrung out. Following this the limbs should be well massaged, working from the fetlocks towards the body.

Prevention and Control.

Although there is no evidence to indicate that the disease is contagious, it is advisable to isolate the sick animals, particularly so when only a few cases of disease have occurred.

Sick animals or those that have recently recovered should not be travelled, as this may lead to the spreading of the disease.

However, as the infection is probably also spread by winged insects, it is not possible to confine it to any specified areas by quarantine measures. Nevertheless, owners are advised not to allow cattle from known infected holdings on to their property, for such animals may act as a reservoir, from which the disease will become established.



UNSETTLED weather prevailed during the month of November, storms yielding over an inch of rain being received at many centres. Unfortunately, the falls have not been general, and, following on a long dry period, are totally insufficient to promote plant growth or greatly revive pastures. Where heavier rains have been received it will be possible to proceed with the sowing of summer crops such as maize, sorghum, peanuts, and general fodder crops, but even in such favoured areas further rains will be required in the near future to maintain growth. A large area of land has been prepared for summer sowings, awaiting favourable conditions, as farmers are particularly anxious to replenish their fodder reserves as well as to provide for present urgent requirements.

WHEAT.

Harvesting was practically finalised by the end of November, ripening being accelerated by the dry seasonal conditions. Although the aggregate yield will be below average, the quality of the grain is excellent, a high proportion being suitable for seed purposes. Some excellent yields are reported from individual areas, where early fallowing was practised in order to conserve moisture resulting from summer rains. The large area hurriedly prepared towards sowing time, together with that sown principally for feed, results in considerably lowering the State's average yield per acre. This is particularly noticeable during a period of under-average rainfall.

In the Dawson Valley and Callide districts, where a small area is placed under wheat, the resultant yield has been very satisfactory despite the low rainfall received during the growing period of the crop. On the Downs many crops have been cut with the binder in order to conserve straw. This draws attention to the fact that during the present season many farmers would have received a higher return by marketing their crops as hay or chaff. Owing to the partial failure experienced by many growers, the cultivation of wheat as a summer crop has been suggested. Although accurate experimental work has not been carried out in this direction, it is known that individual farmers have raised satisfactory crops from November and December sowings, and also from self-sown areas where the grain has been broadcast by storms. However, summer sowings cannot be recommended owing to the risk of severe rust infestation reducing yields to an unprofitable

level. Growers attempting summer wheat sowing are therefore advised to give the land an adequate preparation, and to sow rust-resistant varieties such as Three Seas not later than December, as ripening will naturally be retarded with the approach of cooler weather.

COTTON.

The desire for good general planting rains during November has unfortunately not been fulfilled, and several important cotton areas are still awaiting sufficient moisture to allow of planting. Scattered storm rains, however, have fallen over a considerable portion of the cotton belt in sufficient quantities to allow of planting. These areas include the Lockyer and Brisbane Valley, the South Burnett, and portions of the Upper Burnett and the Callide.

Although the general planting will be late, from previous experience there appears to be no reason why profitable yields should not be obtained, for it has been noticed in past years that later plantings, instead of being somewhat restricted in their earlier growth, develop at a quicker rate than do earlier-planted crops.

Seed distribution is still being carried out, and to the 13th November sufficient to plant 57,310 acres has been allotted, and it is anticipated that this season's plantings will be about the same as last year.

SUGAR.

Dry conditions throughout November have seriously retarded the crop in the far North, though timely rains have now relieved the position.

In the central and southern districts light but beneficial storms have improved growing conditions markedly, and the crop prospects in those areas are now reasonably good.

Several mills have completed their harvest, and all report a generally satisfactory season.

AN EFFECTIVE GATE STOP.

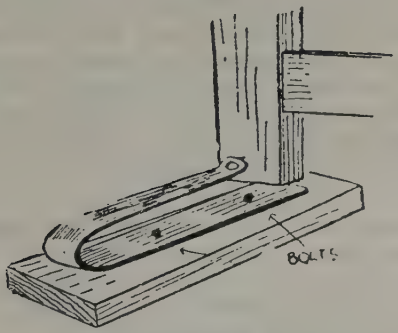


Plate 323.

An effective and easily-operating gate stop can be made from an old rabbit trap. First remove the jaws, plate and cross-piece of the trap, then drill two holes in the bottom-piece. Bolt the trap firmly on to a block of wood fixed in the ground in front of the gate in the open position. Place it high enough to catch the bottom of the gate about half an inch. To release, press the spring down with your foot and pull the gate forward. Instead of the two bolts, iron staples will hold the trap in place on the block.



CITRUS CULTURE IN QUEENSLAND.

R. L. PREST, Instructor in Fruit Culture.

CITRUS-GROWING in Queensland has been mainly confined to the coastal belt, although in recent years it has extended inland to areas of lower rainfall, where suitable water for irrigation purposes is available.

The material success of a commercial citrus orchard depends in a large degree on the location, site, climate, and soil conditions. In the most suitable coastal areas growth is generally more vigorous than in inland districts, but, aided by irrigation, districts with a low rainfall produce a firmer fruit of better appearance and texture. A great deal depends on a regular supply of moisture to develop the full flavour of the fruit, which is not attainable under excess or a fluctuating quantity.

Soils.

Citrus trees thrive and produce good fruit on a rather wide range of soil types, such as red volcanic loams, loams, sandy loams, and sandy soils, providing they are well drained. Although the chemical properties are of great importance, the suitability of citrus soils depends more on the physical properties of the soil. Chief among the physical characteristics are porosity and thorough aeration, coupled, if possible, with depth, to permit perfect drainage.

Shallow soils over-lying retentive clays or rock, are improperly drained and must be classed as unsuitable. Soils of a sandy nature overlying gravelly washes drain too freely as a rule, and are also undesirable. Deep, sandy loams, sandy soils, and deep loams, overlying well-drained subsoils, can be classed as citrus soils.

The most desirable citrus soils are alluvials, deep loams, and sandy loams, overlying a porous subsoil, which in turn overlies a gravelly wash.

Very fertile soils that induce an extremely heavy growth of wood and foliage are apt to be objectionable, because these results are not always conducive to the production of the best crops, nor of fruit of

the best quality and appearance. It is a fact fully supported by experience that the well-drained warm soils preserve the best balance between the vegetative growth of the trees and fruit production. Such soils are usually represented by the lighter types, as heavy types are likely to lack adequate drainage.

In addition to the type as indicated by the surface soil, the subsoil is of very great importance, even greater than the surface soil. The surface may give every indication of being a good citrus soil, and yet the subsoil be of such a character as to make it quite impossible for the commercial production of citrus fruits. For instance, a shallow stratum of soil overlying rock produces a soil condition entirely unsuited for orchard purposes. Under the most favourable soil moisture conditions an orchard planted on such a soil may do well, but it is likely to suffer in times of drought because the reserve of soil moisture is very limited, and in times of excessive rains difficulties resulting from poor drainage are likely to occur.

The nature of the surface soil can be modified by the way in which it is handled, but the subsoil admits of only slight modification by ordinary means, except perhaps by underground drainage, which is generally too costly. If the subsoil is gravelly and over-porous, the trees are likely to feel severely the effects of even a moderate drought, while the other extreme, a heavy clay sub-soil, is very likely to be badly drained. In a badly-drained, heavy clay subsoil the roots in periods of excessive rainfall decay, and the top of the tree commences to die back. Therefore, a soil of this type must be thoroughly drained, yet not over-drained so as to cause the trees to suffer in dry weather. It should be reasonably fertile, and well supplied with humus, otherwise its physical condition will quickly deteriorate, and it will be easily affected by drought and the fertility will be impaired.

Location.

In selecting the orchard site, aspect should be well considered. Citrus trees thrive in a frost-free, well-sheltered, warm situation. In districts where the prevailing winds are such as to interfere with the normal tree growth, belts of standing timber or scrub should always be retained as a protection to the orchard. In inland areas where timber is scarce artificial shelter belts should be planted.

The site should be an area of unbroken, nearly level, or gently sloping land. Steep hillsides should be avoided, as, in addition to the danger of sustaining irreparable losses by soil erosion, the costs of general orchard practices are high. Most centres along the coastal belt are free from damaging frosts. In the Burnett district, however, this is not the case, and on occasions low temperatures have occurred, causing injury to lemons, and, in one or two cases, severe damage to young citrus trees. In such districts care should be exercised to avoid hollows and low areas where frosts are likely to be experienced.

Varieties.

A wide range of varieties of citrus trees has been catalogued, many of which are not worthy of space in the orchard. When making commercial plantings it is advisable to confine the selection of varieties to the narrowest limits. Productivity and market demands are the essential requirements to be kept in view, and these can only be obtained by confining attention to the variety or a few varieties of recognised merit best adapted to the district or locality in which they are to be planted.



Plate 324.
Jaffa Orange.



Plate 325.
Jaffa Orange. Cross-section.

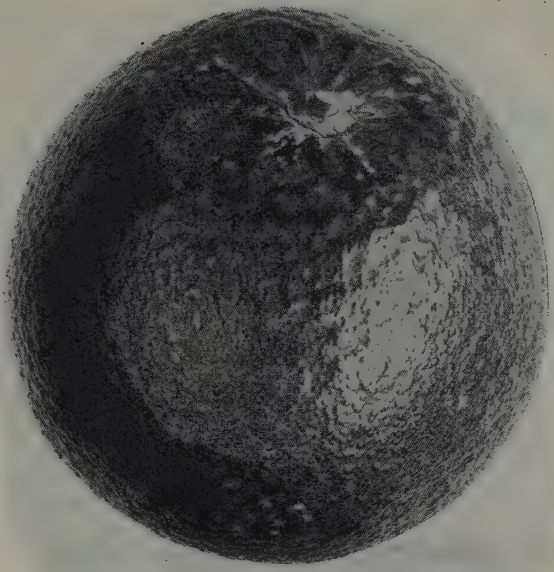


Plate 326.
Valencia Late Orange.



Plate 327.
Valencia Late Orange. Cross-section.

Oranges.

Washington Navel.—Form, somewhat rounded, tapering towards the apex; size, large; navel marking at blossom end; base rounded, somewhat flattened, and frequently creased; sections, from nine to eleven, well-defined; flesh, rather coarse; juice sacks rather large; juice plentiful; flavour rich, vinous; quality excellent.



Plate 328.
Joppa Orange.

Valencia Late.—Form, round or oval; size, medium to large; apex rounded, flattened, scarred; base smooth, rounded; juice abundant; sections clearly marked, nine or more; flavour rich, vinous; quality excellent; seeds few (six), large, plump, and oval.

Joppa.—Form slightly rounded, oblong; base rounded, somewhat flat; sections, from ten to eleven, well defined, fairly regular; flesh fine-grained; flavour rich, vinous; seeds, about nine, short, rounded, and plump.

Jaffa.—Form, long oval; size, large; skin, smooth, but coarse and thick at stem end; colour light yellow; flesh, fine, rich, and juicy, with little rag; sections, from ten to eleven, regular; practically seedless.

Siletta.—Form rounded; medium firm; pale orange colour; rind smooth, fairly thin; flesh fine; juice of good flavour; seeds very few; divisions regular; season, early.

Mandarins.

Beauty of Glen Retreat.—Form oblate, flattened; sections showing through rind; size medium; rind smooth, glossy, very thin; sections, ten or more, clearly defined; rag almost entirely lacking; juice plentiful; flavour distinct, rich, vinous; acidity and sweetness well blended; seeds few, small.

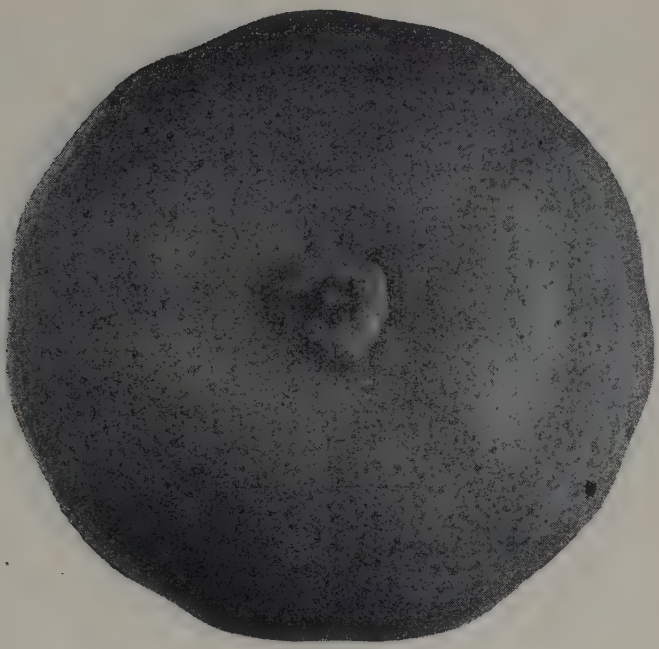


Plate 329.
Beauty of Glen Retreat Mandarin.



Plate 330.
Beauty of Glen Retreat Mandarin. Cross-section.

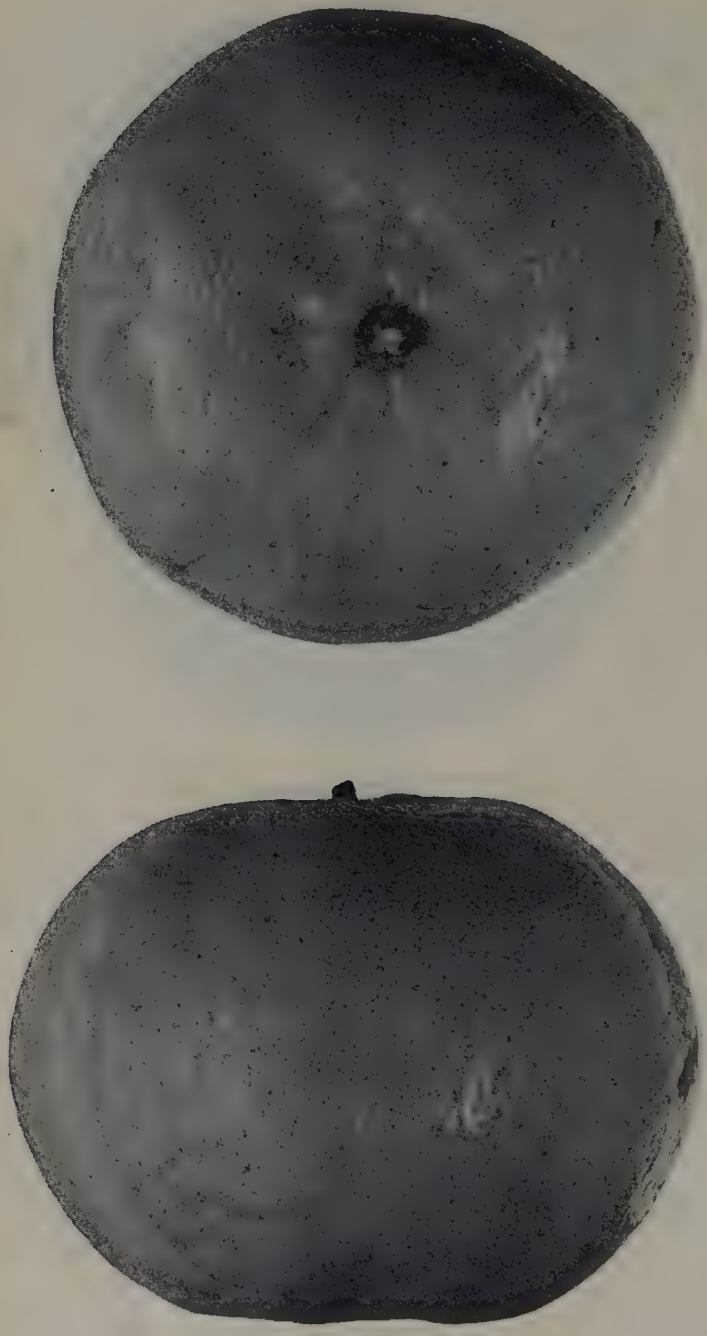


Plate 331.
Emperor Mandarin.

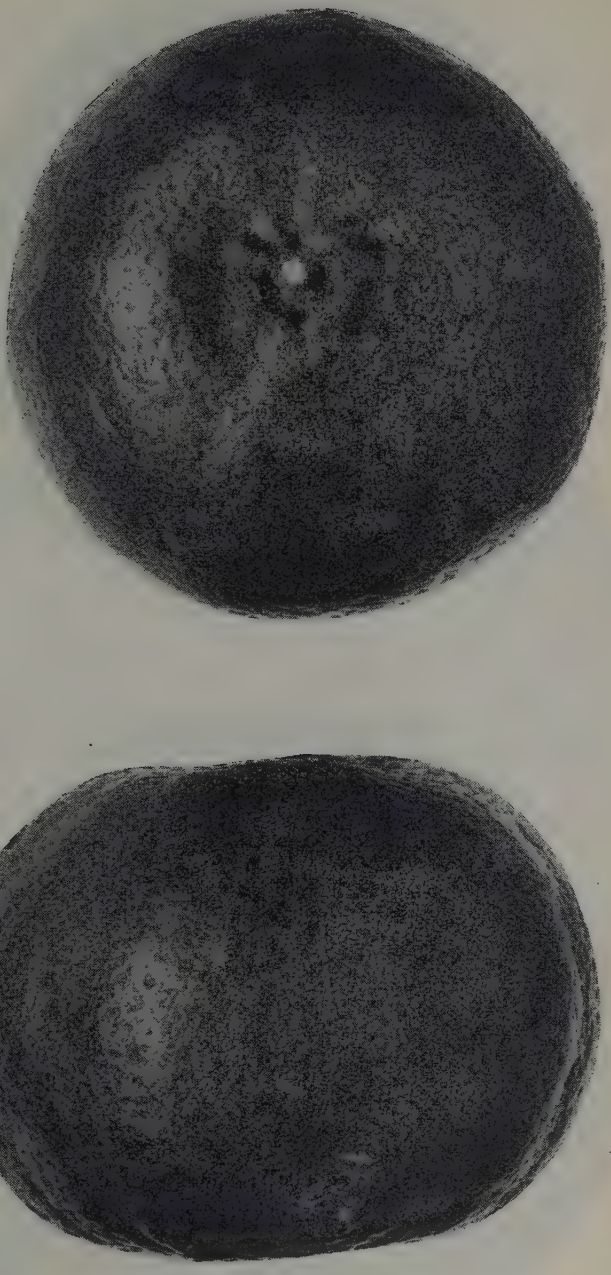


Plate 332.
Solid Scarlet Mandarin

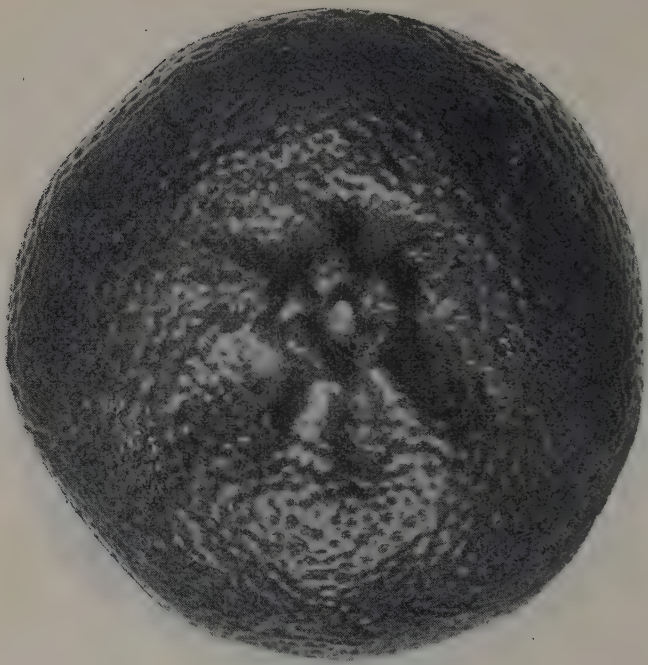


Plate 333.
Scarlet Mandarin.



Plate 334.
Ellendale Beauty. Late Mandarin. Dry Districts Under Irrigation.

Emperor (*Emperor of Canton*).—Form roundish, flattened at ends; skin yellow in colour, brittle, medium to thick; parts readily from fruit; size, medium to large; rag plentiful; flavour good; seeds, few.

Scarlet.—Form oblate, flattened; size, medium; rind rough, thin, rich reddish-orange colour, more or less detached from flesh; distinct fibrous network between skin and pulp; flesh, dark orange colour; juice plentiful, sweet flavour; seeds numerous.

Grapefruit.

Marsh's Seedless.—Form oblate, roundish; colour, pale lemon-yellow; medium thick rind, smooth; sections, thirteen, regular; juice sacks, small; flesh, greyish green; flavour, good, bitter principle not very marked, acidity and sweetness good; seeds, from two to six, or none, large and plump.



Plate 335.
Marsh Grape Fruit.

Thompson.—A pink-fleshed form of Marsh's Seedless, being a bud-sport of a Marsh tree; usually typical of Marsh's Seedless except for pinkish flesh.

Duncan.—Form oblate; colour, pale lemon yellow; rind smooth; sections, fourteen; large; bitter principle strongly marked; acidity and sweetness good; quality very good; seeds, fifty, large, plump, blunt, not winged. Duncan is a variety of superior quality. The large juice sacs make it possible to easily remove the pulp from the sections.

Foster.—Form oblate; stem small; colour pale yellow; rind smooth; sections thirteen, large; bitter principle strongly marked; flesh pinkish; acidity and sweetness good; seeds fifty-eight, large, plump, wedge-shaped or irregular; season early.

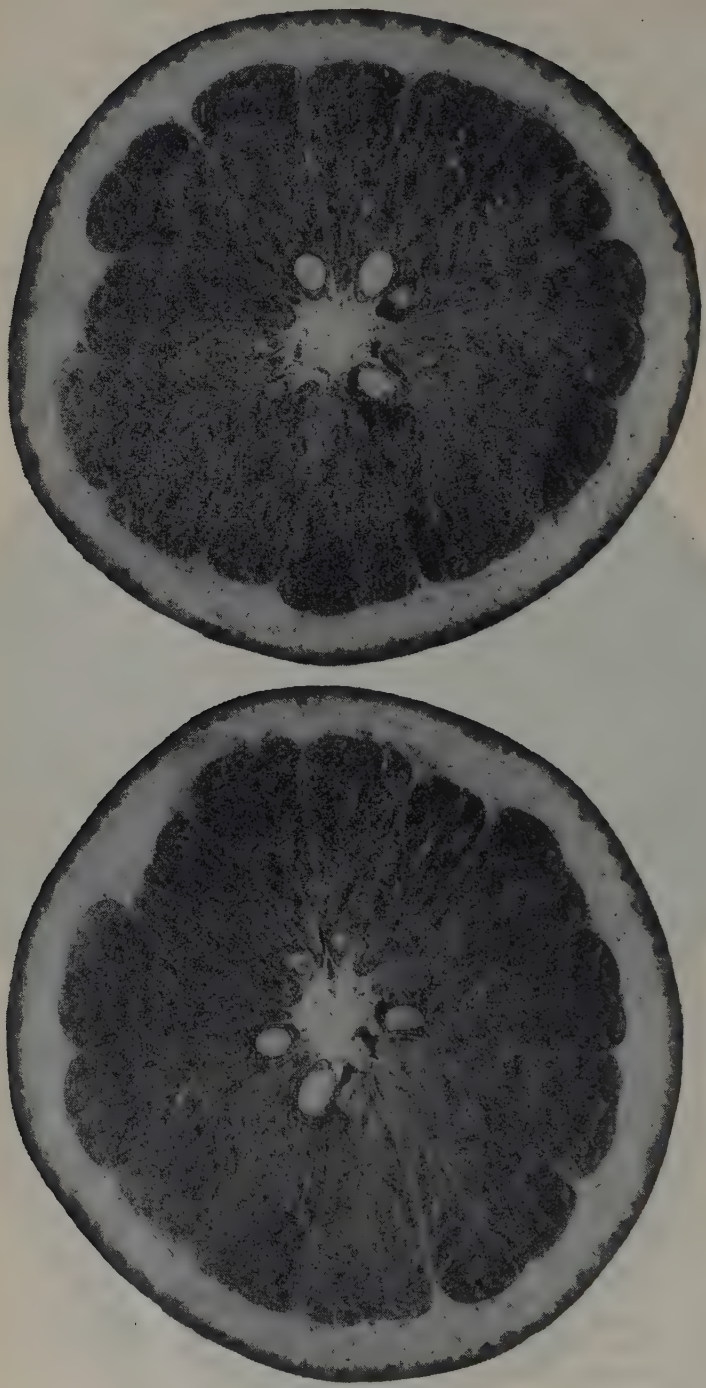


Plate 336.
Cross-section of Marsh Seedless Grape Fruit.



Plate 337.
Duncan Grape Fruit.



Plate 338.
Duncan Grape Fruit. Cross-section.



Plate 339.
Thompson Grape Fruit.

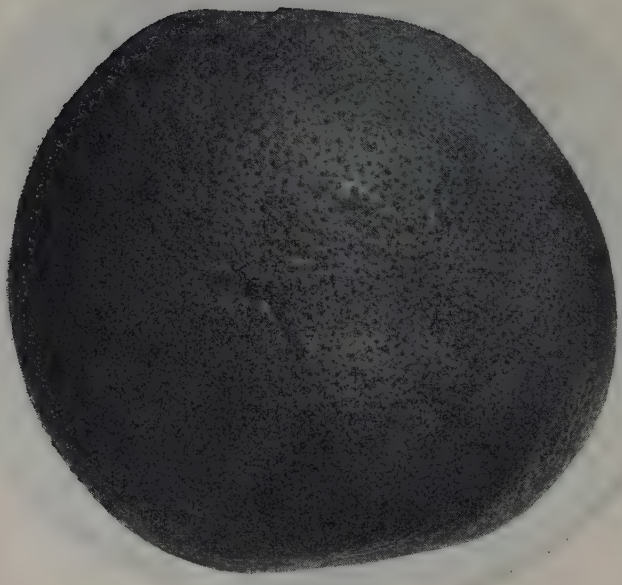


Plate 340.
Imperial Grape Fruit.

Lemons.

Villa Franca.—Form, oval oblong; size, medium to large; apex, pointed blunt, abrupt, about half in. long; base rounded; segments not distinctly marked; rind smooth; sections, eleven, well-defined and regular; juice colourless, abundant; flavour good; seeds, thirty, medium size, oval, pointed; tree has few thorns, is a good grower, and very productive, tending to summer fruits.



Plate 341.
Villa Franca Lemon.

Lisbon.—Form oblong; size, medium; apex nippled; base somewhat necked; rind fairly smooth; sweet; sections, from ten to eleven, regular, small; juice abundant; flavour excellent; seeds, from one to five, usually abortive, oval. This variety is a strong grower, prolific, thorny, and well-covered with foliage.

Genoa.—Form oblong, pointed at both ends; size medium; apex nippled; nipple small and rather pointed; rind smooth; sweet; sections, seven to ten, regular; juice abundant; flavour excellent; the tree is thornless, dwarf in habit, and fruit keeps well.

Eureka.—Form oblong; size medium; apex nippled, small and abrupt; base slightly tapered, frequently oblique; rind smooth; sweet; sections, ten, well-defined and regular; juice abundant; flavour excellent; seeds present, mostly abortive, elongated, somewhat wedge-shaped, and small.



Plate 342.
Lisbon Lemon.

Stocks.

A good root stock requires to make a good physical union with the scion, to produce a long-lived tree resistant to disease, to assist the production of quality fruit with long-hanging habits from the first year of bearing, to be resistant to cold, and to be adapted to the particular soils on which the planting is to be made.

In Queensland the majority of citrus plantings have been made on either seedling sweet orange or rough lemon root stocks. The sour orange stock, although reputed to be somewhat hardier than the two former, has not been used to any great extent, perhaps on account of its somewhat slower growth.

The seedling *sweet orange* is an excellent stock on which to work oranges and mandarins, and even lemons give satisfaction when planted on perfectly-drained soils. Trees worked on orange stocks make a good bud union, and are thrifty and symmetrical; also the fruit produced is of good quality and fine texture. It is, however, susceptible to collar rot, and should not be planted in low and clayey soils where water is likely to lie for any period. Sweet orange stocks should be budded high, as the bud union is considered to be the weak point in relation to its susceptibility to collar rot.

The *rough lemon,* like the sour orange, is reputed to be more or less resistant to collar rot, although some authorities contend that this is not so. Although lemon roots show a wide variation, most trees worked on this stock have a well-distributed rooting system. The rough lemon induces a rapid growth on scions top-worked on to it, a tall upright type of growth usually being produced. First crop fruits are usually thick-skinned, deficient in juice and flavour, and poor hangers compared with fruits grown on sweet or sour orange stocks of equal age. Rough lemon stock is used on account of its resistance to collar rot, although this partial immunity is not as great as is generally believed. When planted too deeply, or when planted on clayey soils, trees budded on rough lemon stock frequently develop collar rot.

Sour Orange.—With the exception of Trifoliate, the sour orange is credited with being the hardiest of stocks, and is used to some extent in the Southern States. It is usually a good rooter, and penetrates well into the soil. Trees on this stock usually suffer less in periods of drought than trees growing under identical conditions on rough lemon stocks. This stock is also resistant to the attack of collar rot and allied forms of gum diseases. The sour orange is, however, susceptible to scab, which is frequently a drawback in the production of stocks for budding.

Propagation.

Only seed from clean healthy and vigorous seedlings of known performance should be sown in the seed bed. When large enough (about six inches high) the young seedlings are planted out in nursery rows at distances of up to twelve inches apart, the rows being about three feet apart. When the stocks have attained a diameter of some three-eighths of an inch at the base and have the sap flowing freely, they may be budded. In Queensland this operation is usually performed during the spring or autumn, but it may be continued as long as the sap in the stock is flowing freely.

When the stock is ready to receive the bud, a perpendicular cut is made in the bark at or near the base. The cut should be from one to one and a-half inches in length, and in depth through the bark to the cambium layer. The cut should preferably be made on the south side of the tree, as on that side the bud will not be so readily dried out by the sun. Another cut is then made horizontally across the top of the perpendicular one, so that the two together appear thus—T.

Budwood should be taken only from selected trees which are healthy and vigorous and noted for their consistent production of heavy crops of quality fruit. Budwood should be well-rounded, mature wood, about one-quarter to three-eighths inches in thickness, and not more than one year old. Before the buds are cut from the bud-stick the leaves are trimmed off so that a piece of the leaf-stalk or petiole is left in each case; the bud can thus be more easily handled after cutting.

The bud may be cut off the stick either from above or below the bud, but the general practice is from below the bud upwards, commencing about half an inch below the bud and ending about half an inch above. The cut must be made with a sharp thin-bladed knife, and be just deep enough to remove a very thin layer of wood. In the absence of thorns the wood may be carefully removed from behind the bud, care being taken not to damage the bud.



Plate 343.

A. B. D.—Too Angled.
C.—Well-rounded Desirable Budwood.
E.—Sleepy Buds.

The bud is then inserted down and under the bark of the stock, where the T cut has been made, by raising the bark with the budding knife. In order to bring the bud and stock into close contact they are then bound tightly together with a raffia tie. In from two to three weeks the bud, if it remains green, will have "taken"—that is to say, it will have united with the stock. The tie may then be cut, and the head of the stock shortened back. Later, when the bud has made good growth and is strong enough to support itself, the head is removed altogether. The young tree should then be staked.



Plate 344.
Well-planned Navel Orchard. Nine Months Planted.

Planting.

The two main systems for planting citrus trees are respectively the square, and the hexagonal or septuple. In Queensland the square system is more generally adopted. It is by far the most common of all systems of planting, and the ease with which a field can be laid out is greatly in its favour. The rows of trees intersect at right angles, so that cultivation may be carried out in either direction.

In the hexagonal or septuple system six trees are set equidistant from a seventh placed in the centre, the basis of the system being a circle. By this method approximately 15 per cent. more trees are planted to the acre than with the square system.

Citrus trees require plenty of room for growth and cultivation. The mistake of close planting has generally been a common one. In the drier areas, where the application of water can be controlled, plantings should be made at least 30 feet apart. This distance, of course, may be varied slightly according to soil and climatic conditions, but it should never be less than 25 feet.

The following table gives the approximate numbers of trees to the acre when planted at distances from 25 to 30 feet apart on the square and hexagonal systems respectively:—

Distance Apart.	No. of Trees Per Acre. Square System.	Hexagonal System.
25 feet	70	80
26 feet	64	73
27 feet	60	69
28 feet	55	63
29 feet	51	58
30 feet	48	53

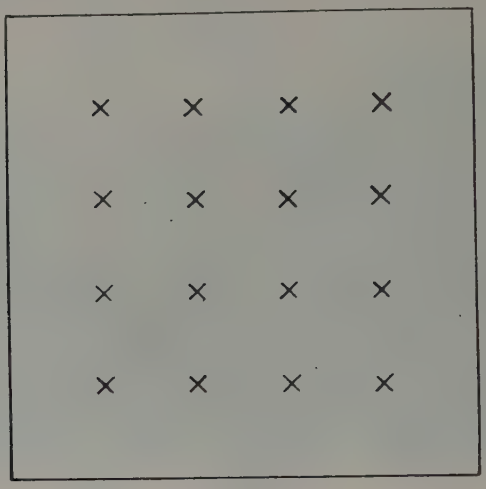


Plate 345.
Square System.

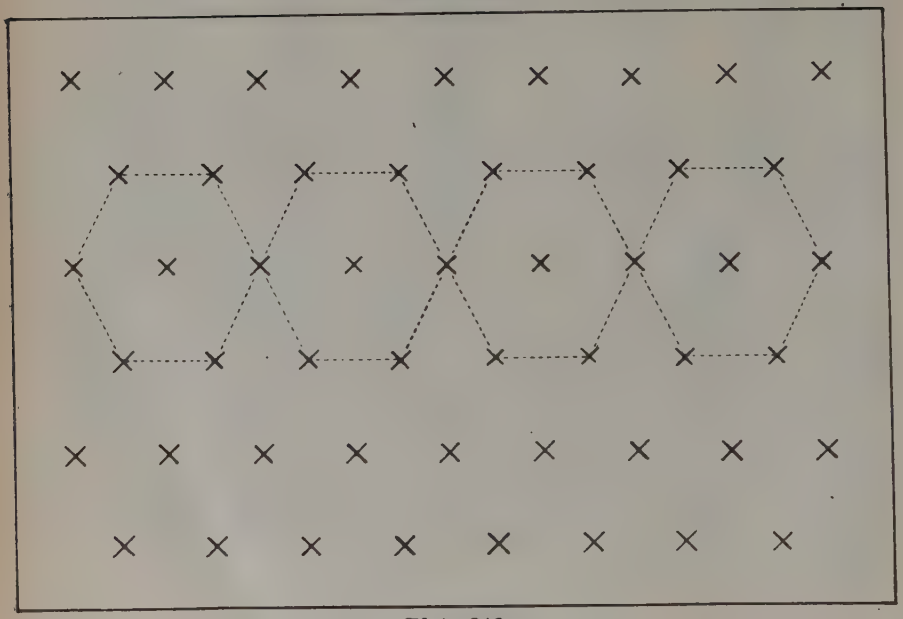


Plate 346.
Hexagonal or Septuple System.

In order to calculate the number of trees required per acre when planting on the square system, multiply together the distances apart in feet, and divide the result into 43,560, the number of square feet in an acre. When planting on the hexagonal system about 15 per cent. more trees than this number will be required.



Plate 347.
Well-planned Lemon Orchard. Twelve Months Planted.

The first essential in planting an orchard is to plough the land thoroughly and sub-soil it, always, however, avoiding bringing the sub-soil to the surface. This can be done by ploughing a furrow in the usual way, followed by a sub-soiler to loosen up the bottom of the furrow before the next sod is turned. Ploughing should be followed by harrowing, working down, and grading.

Having determined the distance apart at which the trees are to be planted, the first step is to measure the longest side of the proposed orchard and use it as a base line. This should be measured from at least 30 feet inside each boundary in order to leave ample headlands for turning purposes.

The base line is best pegged out by a length of fencing wire fitted with rings at each end, and with small buttons of solder fixed at distances along its length corresponding with the distance apart the trees are to be planted. When the base line is struck and the wire drawn taut, pegs should be driven into the ground at the buttons on the wire.

The simplest way to lay out a right angle accurately is by the 3—4—5 method.

With a box tape from the desired point "A" measure along the base line a distance of 15 feet, and insert a peg "F." Then, by holding the ring of the tape at "A" and the 45 feet mark at "F," and going in the desired direction drawing both parts of the tape taut at the 20 feet mark, the line at right angles "AK" will be found. When this right angle line is found, it should be similarly pegged. The pegging of

the square is then easily completed, and from it the rows for the whole orchard can be determined.

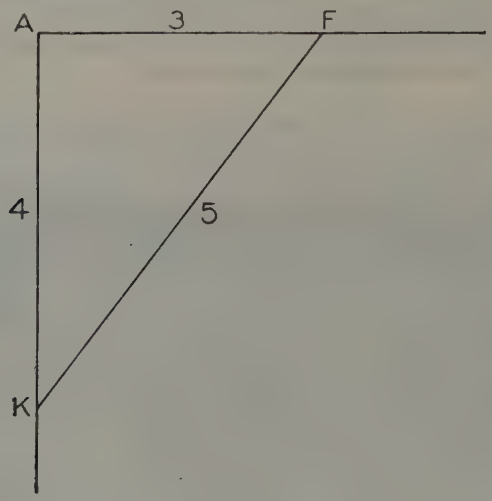


Plate 348.

The 3-4-5 Method of Laying Out a Right Angle.

In planting on the septuple system, lay off and stake the base line as described for planting on the square. Set off the two side lines at right angles, but instead of placing the stakes at the same distance apart as those on the base line, they should only be ·866 of the distance on the side lines, so that if the stakes are 30 feet apart on the base line, the pegs on the side line will be as nearly as possible 26 feet apart. Next place a mark 15 feet from one end of the planting wire, and stretch it across between the stakes on the side lines and parallel to the base line.

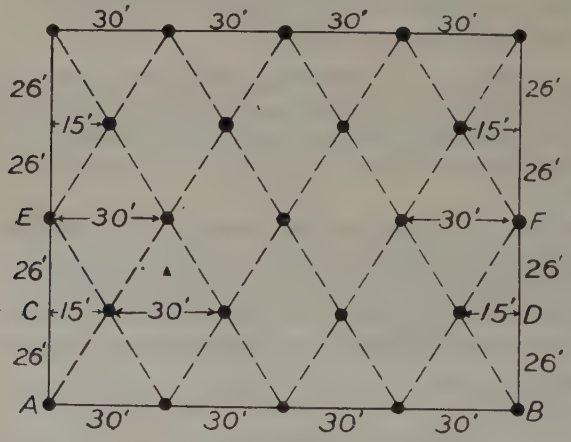


Plate 349.

Plan for Laying Out an Orchard on the Hexagonal or Septuple System.

The base row has already been staked 30 feet apart. On the second row, C D, bring the 15 feet mark on the planting wire to the point C; this will then bring each mark on the wire midway between the stakes on the base line, and stake. For the third row, stretch the wire full length between E and F, with the end of the wire at E. The marks on

the wire will then correspond with those on the base line. For the fourth row, carry on as in the case of the second row, and so on.

To ensure that the young trees are placed exactly in the position occupied by the pegs, a planting board will be found useful, and is easily constructed. A board some four or five feet in length, four or five inches in width and one inch thick, is used, and a "V" notch is cut in the centre, and a similar notch at each end.

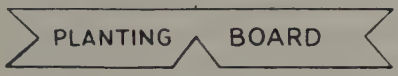


Plate 350.

In use, the centre notch is placed against the peg denoting the position of the tree, and pegs are driven in at the notches at either end of the board. The board and tree peg are removed, leaving the latter two pegs in place. The hole to receive the tree is then dug. The board is then brought into use again, being fixed as before at the ordinary soil level between the two remaining pegs. The tree is then placed in the hole at the centre notch in the board, taking the position formerly occupied by the tree peg, and the soil filled in.



Plate 351.

One-year-old Valencia, Late Planting. Note the paper collars to prevent sunburning the trunks.

[*From photograph by H. Clarke Powell in "The Culture of the Orange and Allied Fruits."*

The planting board serves another purpose in that it ensures planting the tree at the proper depth. The correct depth at which to plant the tree is the depth it was grown in the nursery; the mark can usually be distinguished on the tree. The union of the stock and scion is always a weak spot in a tree and liable to attack from fungus diseases; it should, therefore, be kept above the level of the soil. When using the planting board, the union, if kept level or slightly above the top of the board, will ensure the tree not being planted too deeply.

In digging the holes for the trees, the surface soil should be taken out and kept on one side. The subsoil at the bottom of the holes should be finely broken up. Provided the orchard has been properly prepared, there is no need to dig deep holes; so long as they are large enough to space the roots without cramping they will serve the purpose. A little top soil may be returned to form a small mound at the bottom of the hole. The roots, which should be carefully washed and trimmed, should be spaced as evenly as possible, and with a downward and outward slope of from 40 to 45 degrees. The spaces are then filled with fine soil, and pressed firmly, water being applied and allowed to soak in before the hole is completely refilled with soil. Where there is a danger of the trees being scalded by the sun, they should be protected by cylinders of paper placed around the trunks.

The season for planting will be determined by location and local circumstances. Where low temperatures are experienced, July or early August planting is preferable to autumn, but where there is no danger of frost injury, autumn planting is satisfactory, as it enables the trees to obtain a roothold earlier, thereby materially assisting the early spring growth.

[TO BE CONTINUED.]

RHUBARB-GROWING.

H. J. FREEMAN, Senior Instructor in Fruit Culture.

RHUBARB is indigenous to eastern Asia. It belongs to the buckwheat family, Polygonaceæ, and is a highly popular herbaceous perennial. The succulent stems are used for sauce, in pies, and take the place of stewed fruits in many dessert courses.

Climatic Requirements.

Temperate to subtropical. Occasional frosts during the winter do not damage the rooting system.

Soil.

Deep, rich sandy loams provide ideal conditions for rhubarb, which, however, may be grown successfully on all types of soil once such soil has been properly conditioned.

The large succulent stems require an enormous amount of soil moisture, so that irrigation is especially valuable for this crop.

The earliest marketings usually command the best prices, and warm soils gently sloping to the east are desirable when earliness is such an important factor.

Propagation.

The plants are readily propagated from seed sown under cover or in the open, but as only a small percentage of the plants produced in this way are true to type, the system should not be generally practised. Root division is the method ordinarily employed, and a piece of root containing a strong eye will grow, and under favourable conditions produce a good plant in one season.

In the colder districts gardeners often force a crop by lifting the roots from an old bed during the late autumn, planting good eyes in hot beds or under specially constructed cover, forcing throughout the winter, and planting these well-established plants in the spring.

Planting.

Spring planting is always preferable, and as early as possible, for the plants need the entire growing season for their full development. The usual distances for planting are 3 ft. x 3 ft. or 4 ft. x 3 ft. apart, and the roots are covered with several inches of soil.

Wilson's Ruby, Sydney Crimson, and Victoria Giant are excellent varieties.

Fertilizing.

When fertilizing rhubarb, the grower should consider the following facts:—

1. The plant luxuriates in soils abounding in vegetable matter (humus).

2. Large stalks usually count for better prices.

3. The earliest pullings are in most demand.

4. The crop of any given year depends largely upon the care of the plants during the preceding year.

Stable manure is especially valuable because it supplies humus, conserves moisture, and furnishes plant food. Some growers use up to 25 tons of stable manure per acre, and the general opinion seems to point to autumn being the best time for application.

Fertilizer made up on a 6-10-10 formula and applied at the rate of 1,000 lb. per acre is recommended.

With proper care plantations will produce for a number of years, but it is a mistake to maintain them once the stalks become materially smaller.

It is doubtful if the best profits can be realised in plantings over four years old.

Cultivation.

Thorough tillage throughout the season is highly important. Enormous quantities of water are used by the large leaves and succulent stems, and conservation of moisture is urgent.

At the first operation in spring the mulch of manure should be worked into the soil. Subsequent tillage should be frequent, but not too deep. Some hand weeding is necessary to keep the fields entirly free from weeds. The seed stalks, which generally appear on a small percentage of the plants, should be broken off.

Marketing.

Harvesting begins as soon as the stalks have attained a length sufficient to satisfy the market concerned. The largest stalks are pulled, no attention being paid to the smaller ones, although the smaller ones are far more tender for midsummer use. The second and third year usually provide the heaviest harvest, and harvesting in any year should not continue until the plants are largely exhausted. Rhubarb is essentially a late spring and early summer crop.

Ordinarily the season of marketing lasts for from two to three months. From two to eight stalks are tied in a bunch, and the use of either blue or red tape for tying greatly adds to the attractiveness of the product. The leaves of this plant are definitely not edible.

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit and Packing.

Present prices are not a true indication of the returns to be expected at this period of the year. During the past month storms have afforded some relief from the prolonged dry spell, but notwithstanding this, fruit is still being marketed under drought conditions. It is therefore to be expected that prices for all fruits and vegetables will be subject to sharp fluctuations.

Stone fruits are now on the market in quantities. Early cooking apples have made their appearance, while early peaches from Stanthorpe are also obtainable. Pineapples are still scarce.

Prices on Interstate and Brisbane markets during the last week of November were:—

Papaws.

Only medium supplies were available in Brisbane, where prices for local fruit ranged from 2s 3d. to 4s 6d. per bushel, and for Yarwun and Gunalda fruit from 5s. to 6s. 6d. per bushel and from 9s. to 10s. per tropical fruit case. In Sydney prices were from 8s. to 15s. a tropical case, and in Melbourne from 10s. to 16s.

Mangoes.

The quality of this fruit is improving, and large quantities are coming on to the market. Prices in Brisbane for North Queensland mangoes were from 4s. to 7s. per bushel case; in Sydney selected varieties are selling well at up to 14s. per bushel, and in Melbourne from 14s. to 24s. per bushel.

It must not be forgotten that only selected varieties are suitable for the Southern markets, and it is also recommended to wrap each fruit and "nest" or pad with woodwool all around.

Pineapples.

Prices are still being maintained at a high level. In Brisbane Smooths realised from 8s. to 14s. per case, and from 2s. to 9s. per dozen loose; Ripley were from 9s. to 12s. a case and 2s. to 8s. a dozen, and Northern Roughs from 8s. to 12s. per case. Sydney prices ranged from 12s. to 16s. per case, Melbourne prices from 14s. to 20s., with special Bowen fruit to 24s., and Adelaide prices up to 30s. per case.

Woodwool, and not blady grass, should be used for packing material for pineapples.

Bananas.

Much poorly-filled and angular fruit is arriving on the market. Growers must remember that, if fruit is packed to a minimum length for each size, there is a great risk that the girth of this fruit will not be sufficient to pass the grade standard. Cases containing fruit of this grade have caused trouble in the markets during the last week or two. The shortage of some of the other fruits used in making canned tropical fruit salad has caused a stoppage in canning, resulting in the smaller bananas which are usually used for this purpose being hard to move on

the market. The great quantity of small, angular fruit going south presents a serious problem. Growers should remember the disastrous holiday markets in previous years and refrain from sending large quantities of fruit south for sale during the Christmas and New Year periods.

Brisbane prices were: For Cavendish, 8's and 9's from 7s. to 13s., 7's from 4s. to 11s. 6d., and 6's from 4s. to 7s. 3d. a case, with bunch lots from 1½d. to 6¾d. per dozen; Lady's Fingers sold at from 1½d. to 8d. per dozen, and Sugars from 1½d. to 4d. per dozen. In Sydney 8's and 9's sold at from 12s. to 15s., 7's from 11s. to 13s., and 6's from 9s. to 11s. a case. Melbourne prices for 8's and 9's were from 11s. to 12s., for 7's from 9s. to 11s., and for 6's from 7s. to 9s. a case. In Adelaide prices ranged from 10s. to 16s.

Passion Fruit.

The demand for this fruit is still good, but with the increased supplies prices have eased somewhat. Remember when packing to exclude from the first grade all crinkled fruit.

In Brisbane first grade fruit realised from 7s. to 10s. a half-bushel, and second grade from 5s. to 6s. Sydney prices were from 5s. to 14s., and Melbourne prices from 8s. to 12s., with a few specials higher.

Citrus Fruits.

Prices for all citrus fruits on the Brisbane market have been maintained, viz., oranges at from 7s. to 9s. a case, and lemons (local) from 4s. to 9s., and Gayndah from 10s. to 14s.

Tomatoes.

The quality of tomatoes generally has been poor. Brisbane prices for local fruit were: Ripe 3s. to 5s., choice 6s. to 8s., green 3s. to 8s., and firm coloured 4s. to 12s. In Sydney local fruit brought from 8s. to 12s., and Adelaide hothouse tomatoes from 12s. to 16s. In Melbourne local fruit realised 12s. to 24s. per bushel, and Adelaide hothouse fruit 12s. to 16s. a half-bushel.

Deciduous Fruits.

Stone fruits have made a welcome appearance, and some excellent lines have been handled.

Cherries.—These have been arriving in excellent condition. Some consignments have had fruit on the small side, but otherwise the condition has been good. Brisbane prices for New South Wales fruit have ranged from 4s. to 7s. per tray, and for Stanthorpe fruit from 7s. to 8s.

Peaches.—Prices for Mayflowers ranged from 4s. to 8s., with specials to 10s.; Sneyds brought from 3s. to 6s.; and China flats from 1s. to 2s. 6d. per tray.

Apricots.—Prices were from 2s. to 5s. a half-bushel, with choice fruit from 7s. to 10s.

Plums.—Small fruit sold at from 3s. to 4s. a half-bushel, and choice from 5s. to 6s.

When handling stone fruits every care must be taken to prevent skin abrasions which will provide a quick means of entry for Brown Rot. All sizing implements, etc., should be periodically sprayed with a 5 per cent. solution of formalin once a week.

Apples.—Some early cookers have arrived, and realised from 6s. to 7s. a half-bushel. There is only a limited market for fruit of this type, which must be of good size to command a price. Any great influx of immature apples will certainly spoil the market. Prices for other imported varieties were as follows:—Granny Smith, 14s. 6d. to 16s. 6d.; Sturmers, 11s. to 14s.; Democrat, 10s. to 14s.; Yates (2½ inch), 12s. to 13s., (others) 7s. to 10s.

Vegetables.

Brisbane prices for cucumbers ranged from 8s. to 11s. per bushel, and for beans from 14s. to 23s. a sugar bag. New South Wales peas realised from 5s. to 14s., and Victorian peas 20s. to 23s. per 50 lb. bag. Lettuce sold at from 6d. to 2s. per dozen. It is pleasing to note the increased quantities of lettuce now being packed in the tropical fruit case, much to the betterment of the article.

Publications.

A peach packing chart will be ready for distribution early in December, and a pamphlet covering the complete operations of marketing and harvesting will be available later.

Pamphlets on banana marketing and passion fruit marketing are now in the hands of the printer, and should also be available during December.

BOOKS BY POST.

What do you read? Do you like books from which you can learn something—say travel books or biographies? Do you like novels of the best authors? If you do want books of this nature, then the library you want to join is at the Department of Tutorial Classes, Brisbane. As a matter of fact, you can borrow books on almost any subject from that library. Another advantage of it is, too, that if you do join you will have a catalogue sent you containing the titles of all the books in the library listed under their respective subjects. It is usually very difficult to know just what books there are in a library, even when you can go and visit the library yourself. But when you can have a catalogue to take home, look through, and read at your leisure, you have a chance of picking out just the very books that you want to read. This catalogue is issued free to members. The cost per year for membership is only 18s. 6d. Members may borrow three books and a magazine at one time, and may exchange these as often as they like. The principle usually followed is to change one or two at a time, so that members may always have one or two books on hand, while the others are travelling to and fro by post or rail. Why not write and get more information about this library? Write to the Director of the Department of Tutorial Classes, corner Edward and Ann streets, Brisbane.

New Highways in Queensland.

THE Main Roads Commission is the major organisation in Queensland for applying the Government policy of building State highways, main, developmental, secondary, mining access, and tourist roads. The Fifteenth Annual Report of the Commissioner for Main Roads, Mr. J. R. Kemp, is an impressive record of rural road development under that policy during the past year.

Under the direction of the Government a vigorous constructional programme involving the completion and opening for traffic of 394·46 miles of new works was carried out.

In addition, 82·9 miles of previously improved roadway were converted to a higher type to meet the demands of increased traffic. At the close of the year 233·12 miles of new works and 113·2 miles of stage construction were in progress, the total mileage of constructed road being 3,627·78, inclusive of the sections which have been remodelled for increased traffic.

Bridges of all types to an aggregate length of 7,695 lineal feet were completed, many of them forming essential links in the road schemes undertaken; 4,192 feet of bridges were in hand at the 30th June. The total length of bridges completed at 30th June was 11·38 miles.

The maintenance programme for the year, in addition to providing for adequate attention to previously constructed sections, covered considerable assistance to local authorities for the purpose of maintaining traffic on unconstructed sections. In all, 11,500 miles of road were maintained.

This programme involved the continuous employment of an average of 3,229 employees.

Through the courtesy of the Commission we are able to reproduce in following pages a series of excellent illustrations taken from the report, and which give some indication of the immense importance of a great national service.



Plate 352.

LANDSBOROUGH SHIRE.—Bruce Highway Tourist Road (Landsborough-Beerwah Section). Two 3/30-feet span timber bridges over Back Creek.



Plate 353.

Bauhinia Shire.—Carnarvon Highway No. 13—Connection between Maranoa District and Springsure, in Central District.



Plate 354.

Bauhinia Shire.—Springsure-Bauhinia-Duaringa Highway No. 3. Staircase Range section. Replacing one of the few remaining bad sections between Springsure and Rolleston.



Plate 355.

MOUNT MORGAN SHIRE.—Dawson Highway No. 25. New road near Mount Morgan under construction.



Plate 356.

Barcoo Shire.—Yaraka-Windorah Road. Deep Creek Crossing. Cement grouting of stone pitching on batters in progress on portion of Welford Deviation which will shorten the road 8 miles and avoid flooded flats near the Barcoo River.



Plate 357.
Bridge over Bradley's Gully on the Charleville-Adavale Road at Charleville. This modern reinforced concrete slab bridge replaced an old timber structure.



Plate 358.
FITZROY SHIRE.—Kabra-Stanwell Road. Cement penetration invert about 10 miles from Rockhampton. This road provides a link with farming districts immediately west of Rockhampton.



Plate 359.

Pine Shire.—New reinforced concrete and steel girder bridge over Pine River, which replaced an old timber bridge and avoided a bad alignment under a railway bridge.



Plate 360.

Mechanised Road Construction.—Drag spreader for pre-mixed bitumen ready to be attached to tipping truck. The truck hauls the spreader and discharges the mix for dragging.



Plate 361.
TOWNSVILLE CITY.—Hynes Road to Castle Hill.



Plate 362.
View of Razorback, near Mount Morgan.



Plate 363.
Pile casting, Sydney Street bridge, Mackay-Habana Road.



Plate 364.
A picturesque bend in Bee Creek Road, Mackay District.



Plate 365.
PIONEER SHIRE.—Mackay City and Mackay-Habana Road. Sydney Street Bridge, Mackay—Fabrication of pile reinforcement, showing temporary clamps. The bridge will be 1,474 feet long, and overall width of roadway, including footpaths, 30 feet.



Plate 366.

Banana Shire.—Dululu-Bunerba Road. Bridge over Dee River, timber superstructure, bitumen deck-wearing surface on concrete cylinders.



Plate 367.

A straight stretch on the Biloela-Valentine Plains Road, Banana Shire.



Plate 368.

On Blacksoil Country.—The Theodore-Cracow Road before construction. A formed and metalled all-weather highway now carries the heavy traffic to the goldfield.



Plate 369.

Causeway over Yowah Creek on the road from Cunnamulla to Thargomindah.

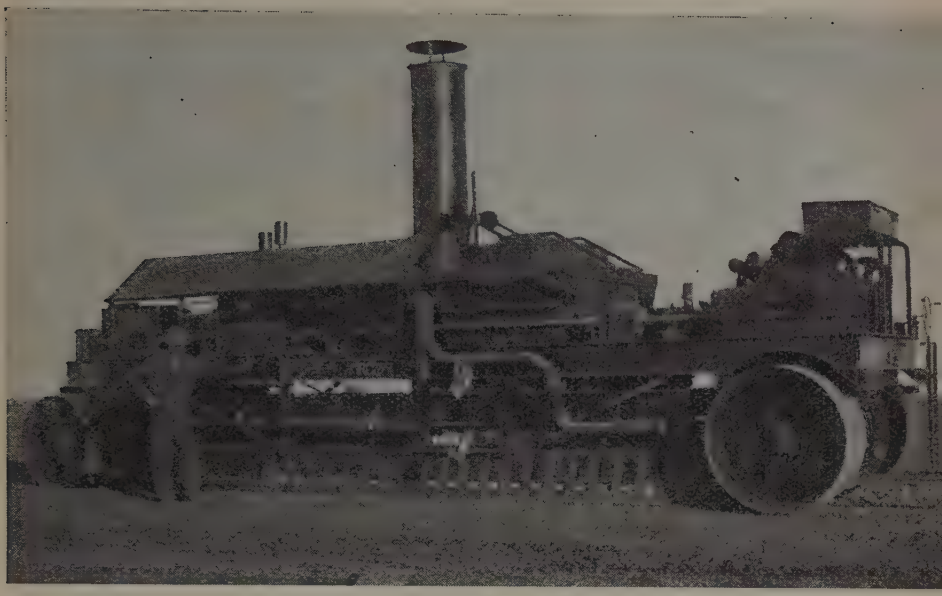


Plate 370.
New Heat Treatment Machine (Irvine Process) at work on blacksoil country in the West.



Plate 371.
Road "roasting" by the new Heat Treatment Machine between Bollon and Cunnamulla.

THE SOUTHERN CROSS.

Subjoined are interesting extracts from a paper read by Mr. Dudley Eglinton at the last meeting of the Queensland Astronomical Society.

IN my paper on the Southern Cross, which was read at a meeting of the Queensland Astronomical Society on October 1, 1927, I did not deal with the fact that the Cross appears to be more than an hour late in arriving at its western elongation (position III as on the clock-face). In the present paper, written as an addendum to the previous one, I give further particulars on that subject.

In discussing the matter with Mr. Chapman he seemed to think that he had arrived at a solution of the problem when he stated that it was owing to the difference of angle from which the observations were made. In his calculations (made a few months ago at his residence, Ellerslie, Munro street, Auchenflower), Mr. Chapman gives 92 minutes as the amount of retardation in the Southern Cross reaching its western elongation. This tallies exactly with particulars given in Mr. Baracchi's paper: "The Stars on the Ensign of the Australian Commonwealth."

In accordance with the dictum of Lord Kelvin, that he was never satisfied with each step in advance until he could prove it mathematically, I now supply the following calculations concerning the Southern Cross. The figures dealing with the rising and setting of it are derived from calculations made in working out the rising and setting of the planets in accordance with their relative positions with regard to the sun.

On September 23 this year the sun was at R.A. 12 Decl. 0·5 north. For the Southern Cross as a whole I have taken R.A. 12.25, Decl. 60 degrees south. Let anyone observe the time at which the Cross arrives at its western elongation. It will be found that it is an hour and a half later than the time which can be calculated for its arrival at that position if he depends on the ordinary method that is employed in calculating the times of rising and setting of the planets.

In a letter from Dr. Baldwin, Government Astronomer, Victoria, dated January 23, 1936, he says: If you allow for the difference in longitude between Brisbane and Melbourne the time agrees with that of Mr. Baracchi.

Let us consider for simplicity (what is actually very nearly the case) that the great circle through the pole and Alpha Crucis passes also through Gamma Crucis. This great circle crosses the meridian at the time given. Six hours earlier it passes through the east point of the horizon—that is, the line from Gamma Crucis to Alpha Crucis will be sloping downwards somewhat. A little later Gamma Crucis and Alpha Crucis will have the same altitude. Later still, five hours before it crosses the meridian, Alpha Crucis will be at its greatest elongation east.

Think of a circle on a plane with tangents drawn from a point outside. These tangents do not touch at the end of the same diameter, but the angle included between the radii drawn to the points of contact is less than two right angles. So in the present case Alpha Crucis is describing a circle about the pole as a centre. Vertical circles drawn through the zenith to touch this circle give the greatest elongation east and west. The angle between the great circles through the pole to these points of contact is not two right angles, but (for Alpha Crucis) about

150 degrees, which corresponds to ten hours in time. Half of this, five hours, is the time between greatest elongation and meridian passage.

This information, so courteously given by Dr. Baldwin, is of very great importance to me.

Thirty-three years ago I was shown by Mr. Sapsford, a printer, Adelaide street, Brisbane, a paper on the Southern Cross signed Pietro Baracchi, which he had obtained for his almanac conditionally on supplying Mr. Baracchi with a certain number of copies. I was much impressed by that paper, which contained the most valuable information on the Cross ever published. I asked Dr. Baldwin if he knew of any other paper on the Southern Cross at all comparable with it. In reply Dr. Baldwin wrote as late as January, 1936, that he knew of no other paper which could compare with it. I therefore feel that I am in possession of the best information on the Southern Cross that has been published.

For many years past I have made much use of that paper, especially through the Education Department, notably in March, 1915, in giving information on the Cross in Queensland. Up to the present time the "Agricultural Journal" and other publications in Queensland have spread that information month by month.

Mr. Chapman has spread valuable information on astronomical subjects in the past and still continues to do so. His early training in civil engineering is of great value to him at the present time and thus his monthly contributions are absolutely dependable, which is of great importance. Many must have noticed the inaccuracies in astronomical statements which are occasionally given to the public. When Mr. Chapman gives ninety-two minutes as the time of retardation in the Cross arriving at its extreme western elongation I accept that statement without a moment's hesitation.

For the last fifty years I have been in touch with anyone in Queensland having special knowledge of astronomical matters, such as Rev. Mr. Pringle, rector of Christ Church, Milton (who gave up astronomy to become a Church of England minister), Mr. R. H. Roe, of the Brisbane Grammar School, who became Director of Education in Queensland, Professor Priestley of the University, and many others in Queensland. Mr. Curlewis, Government Astronomer of Western Australia, was also one of those to whom I am indebted for valuable information on the subject of the Southern Cross.

The admirable way in which Mr. Chapman dealt with Peltier's Comet recently made it clear that Brisbane is especially fortunate in having his services.

CASE TIMBER.

From observations made in the markets it is evident that some fruitgrowers are not at all particular about the class of case timber cut and supplied to them by millers. The main fault encountered is that the sides of the boxes are cut too thin. Thin side boards bulge outwards when the cases are fully packed, and, as fruit cases when in transit are stacked on their sides, it can readily be understood that some of the fruit must be pressed and bruised. Badly-cut cases are often bought by growers because they are cheap, and in this instance the miller is not to be blamed, as the grower is fully aware of the quality of the cases when he purchases them.

It is false economy to purchase thin-sided boxes, be they ever so cheap, and in their own interests growers should insist upon millers cutting and supplying the best quality. Why spoil the returns from the year's labour through the false economy of trying to save a few pence on case timber?

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advance Register of the Herd Books of Australian Illawarra Shorthorn Society and Red Poll Cattle Society, production charts for which were compiled during the month of October, 1936 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORNS.				
Mature Cow (over 5 Years), Standard 350 Lb.				
Dolly 4th of Sunnymeade	E. C. Althouse, Cloyna, Murgon	10,365·15	372·252	Masterpiece of Oakdale
Junior, 2 Years (under 2½ Years), Standard 230 Lb.				
Fairy Bower Sally	O. E. Jeynes, Raceview	9,929·81	402·081	Blacklands Safeguard
Burnlands Glory	Burnett Bros., Brookfield	7,246·0	248·573	Sunnyview Vain Prince
Highfield Pink 4th	J. A. Heading, Cloyna, *via* Murgon	5,775·05	236·83	Highfields Perfection
RED POLL.				
Junior, 2 Years (under 2½ Years), Standard 230 Lb.				
Marshlands Ruby Far Eastern Springs	C. E. McConnell, Marshlands, Mondure	6,131·05	232·749	Severn Springs Bulwark

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Darling Pea.

Inquirer (Bundaberg)—

The specimen represents *Swainsona galegifolia,* Darling pea or indigo. This plant is found in several different forms in Queensland and New South Wales, the one you send being very common in coastal localities, usually in forest country on hillsides. This plant has been proved poisonous to stock by feeding tests, causing paralytic symptoms in sheep. Some time elapses before the onset of definite symptoms, mostly three to four weeks. Once the paralytic symptoms are established the animal will not recover, but if returned to proper feed will remain in the same condition, becoming neither better nor worse. We have seen cattle on the coast grazing on country heavily infested with your form of the plant, and have never noticed any ill effects, but of course the danger is there. The plant is a legume and should be quite a useful green manure, but there are other species, we should say, which are more easily handled and would give a greater bulk of material for turning in.

Plants from the Lockyer Identified.

D.S. (Project Club, State School, Clarendon)—

1. *Argemone mexicana,* Mexican poppy or prickly poppy (family Papaveraceæ), a native of the West Indies and tropical America, reputedly harmful to stock, but never eaten by them on account of its prickly nature and intensely bitter sap. It has been reported to us that calves have been poisoned by the plants when they were cut, allowed to wilt, and subsequently fed in a softened condition.
2. *Amaranthus viridis,* green amaranth (family Amarantaceæ). This plant is very widely spread over the warmer regions of the world. It is not absolutely certain whether it is a native of Australia or not, but it is believed to be so, as it was collected so many years ago by early botanists. It is not harmful or poisonous. The young shoots can be used as a substitute for spinach.
3. *Helichrysum ramosissimum,* small everlasting (family Compositæ), a native plant. It is not poisonous.
4. *Euphorbia Drummondii,* caustic creeper (family Euphorbiaceæ). The milky sap of this plant is sometimes used by bushmen for applying to sores, and is said to have healing properties. The sap is rather blistering. The plant is reported poisonous to stock, particularly hungry sheep that feed on it heavily on an empty stomach. Ordinary paddock or resting stock do not seem to be affected, or at least are affected very little by the plant. It is a native of Australia.
5. *Chenopodium cristatum* (family Chenopodiaceæ), a small plant of the salt bush or goose foot family, for which we have not heard a common name.
6. This looks like *Chenopodium triangulare,* fish weed, but fruits are necessary to be certain, as superficially it resembles another plant of the same family (Chenopodiaceæ).
7. *Lepidium* sp., a wild cress (family Cruciferæ). There are several species of lepidium native and naturalised in Queensland. They are commonly known as turnip weeds or mustard weeds, and although good fodder, give an exceedingly objectionable flavour to milk and cream. The genus is rather in need of revision, and we find difficulty in supplying specific names to specimens.
8. *Lepidium ruderale,* pepper cress (family Cruciferæ). Much the same remarks apply as to No. 7.
9. *Daucus brachiatus,* native carrot (family Umbelliferæ), a native plant.

Caustic Bush.

W.A.K. (Clermont)—

The specimen represents a very drawn-up form of caustic bush (*Euphorbia eremophila*), a fairly common plant in Queensland, distributed from the coast, where it grows right on the sea-beach, to the far inland. Generally it is left untouched by stock, but competent observers state that death has followed eating it in any quantity, the symptoms being similar to poisoning by caustic creeper (*Euphorbia Drummondii*). The head and neck of affected animals swell up to a considerable size, particularly with sheep, and if the swelling be pierced an amber-coloured fluid exudes and the life of the animal may be saved.

Plants from the North Identified.

T.H.C. (Townsville)—

1. *Raphanus Raphanistrum,* wild turnip, yellow flower, and *Raphanus Raphanistrum,* wild turnip, blue flower. Wild turnip is fairly common as a farm weed in Southern Queensland, and is seen occasionally on vacant allotments in North Queensland. It is quite a useful fodder, but like other members of the turnip or mustard family taints milk and cream rather badly.
2. *Eragrostis cilianensis,* stink grass. This is a small grass, mostly of annual duration, palatable enough in the young stage, but usually rejected by stock in the older. We have been informed, however, that at times horses will eat it readily enough. It has rather a peculiar odour, not objectionable to all people, but sufficient to make it apparently unpalatable to animals.
3. *Eleusine indica,* crow-foot grass. This is a grass very widely spread over the warm regions of the world. It is very common in coastal Queensland, particularly around cow-sheds and yards, vacant allotments, old cultivation lands, and, in fact, anywhere where the ground has been disturbed. It is quite palatable to stock, but, like sorghums and some other plants, it contains in its young and more luxuriant stages a considerable amount of a prussic acid-yielding glucoside. Very little trouble has been experienced with the grass in Queensland, but occasionally losses have occurred from stock eating this grass heavily on an empty stomach. Ordinary browsing stock do not seem to be affected to any great extent.
4. *Euphorbia heterophylla,* dwarf poinsettia. This plant is very common in coastal Queensland. The genus *Euphorbia* is a large one, and poinsettia is simply a section of it. The ordinary garden poinsettia is *E. pulcherrima,* a native of Mexico. The dwarf poinsettia is very widely spread as a weed in most tropical and sub-tropical countries, and is generally regarded as poisonous.

Plants from the Brisbane Valley Identified.

D.C. (Toogoolawah)—

1. (Plant with red flowers) *Asclepias curassavica,* red head. The cestrum, a plant you associated with it has greenish or greenish-brown flowers. The red head or milky cotton bush is also poisonous, but rarely seems to be eaten in sufficient quantity to cause trouble.
2. (Plant like a thistle) *Argemone mexicana,* Mexican poppy, a thistle-like plant very common in many parts of Queensland. It is very rarely eaten by stock owing to its intensely bitter sap, but is reputed to be poisonous. The only cases that have come under our notice have been where the plants have been cut, allowed to wilt, and the subsequently softened plants eaten by calves.
3. *Polygonum hydropiper,* smart weed, a very common weed in swampy country and in low-lying places in South-Eastern Queensland. It is not known to be poisonous.
4. *Verbena bonariensis,* purple top, a verbena, a native of South America, now naturalised in many warm countries. It is not known to possess any poisonous or harmful properties.

If any of these plants were responsible for the trouble we should say No. 1 was the most likely cause.

Bitter Blue Grass.

E.A. (Calen, North Coast Line)—

The specimen represents the bitter blue grass, *Bothriochloa decipiens* (var. *cloncurriensis*), a large grass very common in Queensland. So far as we have observed, stock do not seem to care for it to any extent, although, of course, they will eat it in the absence of other fodder.

General Notes

Staff Changes and Appointments.

Mr. C. I. Mudd, East Brisbane, has been appointed an Inspector under the Diseases in Stock Acts, the Slaughtering Act, and the Dairy Produce Acts, Department of Agriculture and Stock.

Messrs. A. R. Nott and P. F. A. Hardman, Government Veterinary Surgeons, Department of Agriculture and Stock, have been transferred from Blackall to Gympie and Gympie to Blackall respectively.

Mr. J. E. Ladewig, Inspector under the Stock, Slaughtering, and Dairy Produce Acts, Department of Agriculture and Stock, has been transferred from Oxley to Monto.

Mr. F. C. Jorss, Inspecting Cane Tester, has been appointed also Cane Tester for the remainder of the sugar season at the Mount Bauple Mill.

Mr. S. B. Best has been appointed Millowners' Representative on the Tully Local Sugar Cane Prices Board, in lieu of Mr. C. P. Kemmis, resigned.

Mr. Thomas Mee has been appointed Chairman of the Inkerman, Invicta, Kalamia, and Pioneer Local Sugar Cane Prices Boards, vice Mr. A. M. Taylor, transferred. Mr. L. H. Roles has been appointed Chairman of the Isis Local Board, vice Mr. J. G. Fitzsimon, transferred, and Mr. J. G. Fitzsimon has been appointed Chairman of the Moreton Local Board. Messrs. Mee, Roles, and Fitzsimon have also been appointed Agents of the Central Sugar Cane Prices Board for the purpose of making enquiries under section 5 (2A) of the Regulation of Sugar Cane Prices Acts in regard to sales and leases of assigned lands.

Constables S. W. Flewell-Smith (Mirani), V. J. Buckley (Walkerston), and C. F. W. Danford (Kynuna) have been appointed also Inspectors under the Slaughtering Act.

Constable A. J. Sharp, Kajabbi, has been appointed also an Inspector under the Slaughtering Act.

Mrs. Nancy Yaun, Numinbah Valley, Upper Nerang, has been appointed an Honorary Ranger under the Native Plants Protection Act.

Mr. William Williamson, Canungra, has been appointed an Inspector under the Slaughtering Act, the Diseases in Stock Acts, and the Dairy Produce Acts, Department of Agriculture and Stock.

Mr. P. F. Tierney, Innisfail, has been appointed Canegrowers' Representative on the Goondi Local Sugar Cane Prices Board, vice Mr. W. D. Davies, resigned.

Mr. Gordon Lindsay, Maryvale, has been appointed an Acting Inspector of Stock.

Constable J. V. McErlean, Goodna, has been appointed also an Inspector of Slaughterhouses.

Mr. J. G. Sinclair, Torquay, has been appointed an Honorary Ranger under the Animals and Birds Acts.

Mr. J. H. Smith, Entomologist, Department of Agriculture and Stock, has been transferred from Nambour to Brisbane.

The Officer in Charge of Police, Sherwood, has been appointed also an Acting Inspector of Stock.

Acting Sergeant C. P. Doherty, Jundah, has been appointed also an Inspector under the Brands Acts.

Mr. T. W. Kear, East Feluga, has been appointed an Honorary Ranger under the Animals and Birds Acts. The Rev. W. P. F. Morris, Headmaster of the Church of England Grammar School, East Brisbane, and Mr. M. J. Farrington, East Brisbane, have also been appointed Honorary Rangers under the abovementioned Acts.

Hail Insurance.

A regulation has been issued under the Primary Producers' Organisation and Marketing Acts, empowering the Committee of Direction of Fruit Marketing to make a levy on fruitgrowers in the Granite Belt to raise moneys to be applied in establishing and maintaining a Fund for effecting insurance against damage or loss by hail of fruits grown in such area, subject to a poll of growers on the question of the establishment of such Fund.

Animals and Birds Sanctuary at Maryvale.

Timber Reserve No. 402, near Maryvale, has been declared a sanctuary under the Animals and Birds Acts.

Fruit Fly Control in the Stanthorpe District.

A Proclamation and Regulation under the Diseases in Plants Acts have been approved declaring the Stanthorpe, Killarney, and Warwick Districts to be a quarantine area on account of fruit fly for the current season, and prescribing the nature of the quarantine to be imposed in such area. This action is similar to that taken in the previous two seasons, and provides for the placing of traps charged with fruit-fly lure approved by an inspector.

Sugar Industry Ballots.

Regulations have been approved under the Primary Producers' Organisation and Marketing Acts providing for the compilation of rolls to be used in the conduct of ballots for particular levies by the Queensland Cane Growers' Council, Mill Suppliers' Committees, and District Cane Growers' Executives, and for the purpose of the election of Mill Suppliers' Committees and District Cane Growers' Executives.

Cane Growers' Council.

Executive approval has been given to the issue of an Order in Council under the Primary Producers' Organisation and Marketing Acts empowering the Queensland Cane Growers' Council to grant such retiring allowances, pensions, bonuses, or gratuities as it may determine.

Butter Board as a Manufacturer.

An Order in Council has been issued under the Dairy Products Stabilisation Act which will provide that on and after the 26th October, 1936, the Butter Board, constituted under the Primary Producers' Organisation and Marketing Acts, shall be deemed to be the manufacturer of all butter manufactured in Queensland, but not to the exclusion of the actual manufacturer thereof, and shall be bound by the provisions of all quotas from time to time promulgated under the Dairy Products Stabilisation Act.

Control of Brumbies.

A Proclamation has been issued under the Diseases in Stock Acts declaring the Petty Sessions District of Collinsville, comprising part of the Bowen Stock District, to be a district for the control of "brumbies" for the period from 1st November, 1936, to 28th February, 1937.

The Central Sugar Cane Prices Board.

Executive Council approval has been given to the constitution of a Central Sugar Cane Prices Board for a period of three years from the 13th November, 1936, to consist of the following members:—

His Honour Mr. Justice W. F. Webb (Chairman), Mr. T. A. Powell (Canegrowers' Representative), Mr. E. S. Smith (Millowners' Representative), Mr J. M. MacGibbon (Qualified Sugar Chemist), and Mr. A. R. Henry (Secretary).

"Three-day Sickness" a Disease under Stock Acts.

An Order in Council has been issued under the Diseases in Stock Acts declaring Ephemeral Fever or "Three-day Sickness" to be a disease under and for the purposes of such Acts.

Wild Life Preservation.

Picnic Point Reserve, near Rockhampton, has been declared a sanctuary for the protection of native animals and birds.

Stanthorpe Co-operative Hail Insurance Fund.

Executive approval has been given to an amendment of the Regulation made on the 5th November last covering the Stanthorpe Fruit Co-operative Hail Insurance Fund, to provide that notice of damage or loss by hail of fruit in the Stanthorpe area shall be delivered to the Secretary of the Board of Control at Stanthorpe within ninety-six hours instead of seventy-two hours, as previously provided.

Rural Topics

The Carob Bean—A Stock Feed in Drought.

The high value of the Carob bean as a fodder has been emphasised from time to time. The beans are imported into Britain from Mediterranean countries as food for stock, the tree being a native of these countries, and also cultivated there. The tree is considered drought-resisting, and does not appear to be particular as to soil conditions. Trees are thriving on the red volcanic soil of Toowoomba, the black soil of the northern downs, near Moola, and the marly soil north of Miles, Western Queensland.

The seedlings are tender for the first year or two, and require protection from rodents and other animals. Seeds should be sown in a box or bed in the house garden, and when a few inches high the plants may be planted in a permanent position. The roots should not be disturbed more than possible, and care should be taken in transplanting, and the plants protected with wire-netting guards or light hessian.

The virtues of the Carob appear to be becoming known among pastoralists, for requests from local nurserymen for seed to maintain their stocks have been received at the Toowoomba office of the department. Young trees of a fair size in pots are available at local nurseries, and now or up to the end of September is a good time to plant.

Points in Harrowing.

The entire absence of rain during the last few weeks has not been confined to one section of the State; consequently not only are the resultant dry conditions acting adversely upon the winter cereal and other crops already above ground, but are delaying the planting of sugar-cane, potatoes, maize, and other staples, as well as preventing the preparation of further areas intended for summer cropping. On holdings where the latter has not already been accomplished, all energies will be concentrated on the carrying out of such work when rain comes, and care should be exercised at the same time in seeing that the loss of soil moisture, which is more or less inevitable to some extent, is reduced to a minimum. This can be accomplished economically and effectively through the use of the tine harrows, running them to and fro over the field in the same direction after the ploughing or other cultural operation has been done at the close of each day's work. On areas which have already received their final preparation, but which for some reason cannot be sown after rain, it is advisable to adopt the same procedure to restore the surface mulch and prevent the loss of moisture.

It must be realised that tine harrows will produce satisfactory results only on friable soils, so should the soil be of a clayey nature and inclined to run together, a cultivator, tined for preference, should be used for stirring the surface, for on such soils it is inimical to the best result if the mulch is made too fine.

Growing crops—such as wheat, oats, barley, and maize—derive considerable benefit through being harrowed during the early stages of their growth but in all instances the operation should be carried out at right angles to the direction which the crop was sown—that is, across the drills. The harrow should not be allowed to collect rubbish, otherwise many of the young plants will be destroyed.

Growers should not fail to realise that maize is one of the crops on which harrowing can be practised with very beneficial results, although of necessity it can be only carried out during the heat of the day, when the plants are tough and not so likely to suffer injury.

The first harrowing may be given three or four days after sowing, and may be continued until the plants are 6 inches high, resulting in the conservation of moisture and the control of new weed growth both between and in the rows, thereby reducing scuffling and chipping to a minimum, with a commensurate reduction in production costs.

When the all-round benefits accruing from the use of the tine harrows comes to be realised, they will not continue to be the least used implements of a farmer's outfit. They are seen all too frequently propped up carelessly somewhere or lost temporarily in some corner of the cultivation. They should be the most used and highly valued implements in the farm equipment.

Castration of Colts.

The best time of the year to perform this important operation is the spring, when rain has fallen and green feed is available, and before the hot weather has set in.

The colts to be gelded having been yarded over night, it is desirable, before proceeding with the operation, to take precautions against losses through infection of wounds, and to this end the spraying of the grounds and surroundings of the yard where the operation is to be performed should be carried out. Crude carbolic acid or phenol in a solution of 7 ounces to 1 gallon is a suitable disinfectant, and should be sprayed over the ground and rails of the yard.

All instruments used should be sterilized by boiling for at least ten minutes, and should be wrapped in a sterile towel and kept in a box at the yard until required.

After each colt is done the instruments and hands of the operator should be washed in a weak solution of carbolic acid, this solution being kept in a separate vessel, and only sufficient for each disinfection being poured into a dish for the purpose, and then thrown away. The practice of using a petrol tin filled with disinfectant to wash instruments and hands time after time is dangerous.

For unbroken colts the rough and ready methods of roping, choking, and throwing as practised on many stations, is responsible for the loss of many valuable animals. These losses may be minimised if a crush with side gates is available, so that the colt can be haltered and side lines used on him before the gate is opened to cast him.

The colt, having been cast on his left side, the hind legs drawn up to the shoulders and made fast with half hitches; the fore legs can now be secured with the knees bent to the hind feet.

The scrotum, sheath, and penis should be washed with warm water and soap, care being taken to remove any suety deposit from the penis and the cavity at the end of the penis. The left or lower testicle (the colt being on his left side) is seized in the left hand, and pressed until the skin is tight over it; a bold incision from front to back, parallel with the median line is now made, penetrating the outer skin and the tunica, laying the testicle bare. As the incision is made, the cord should be grasped firmly in the left hand to prevent the retraction of the testicle upwards through the canal. When this happens it is sometimes difficult to recover, and the subsequent manipulation in an attempt to bring it down delays the operation, and causes unnecessary shock to the patient. The knife is now slipped between the anterior and posterior portions of the cord, and the latter (posterior), which the muscle retracts, is cut completely through.

The testicle now lies inert, connected by the anterior portion of the cord, which is composed of blood vessels, and should be drawn out until it is taut, without using force, when the emasculator (if that method is being used) should be used close to the belly, with a slow squeezing movement, taking care that the crushing part is nearest to the belly, and the cutting part to the testicle. The cord should be severed as short as possible so that it may not hang below the wound, and so cause complications.

The remaining testicle may now be removed in a similar way.

It is advisable to swab the wound with a solution—1 to 2,000—of chloride of mercury. The ropes may now be removed, and the colt allowed to rise and walk out of the yard, so as to be away from dust.

If the operation has been performed carefully, and all antiseptic precautions taken, recovery should be rapid and no further treatment is necessary, but if undue swelling is noted, the wound should be opened with the fingers, after washing the hands with carbolic solution, so that there may be free drainage, and the wound swabbed with disinfectant.

Some bleeding always occurs, but rarely lasts for more than half an hour, but if copious bleeding persists after that time—as is the case when emasculators have been used carelessly—the stump must be found, and the artery tied with silk thread. If the stump of the cord cannot be found, the canal should be plugged with pledgets of tow or wool soaked in muriate of iron of the same strength as obtained from the chemist, which helps to form clots, and so closes the artery.

Sudan Grass in the Maranoa.

Some excellent quality Sudan grass hay was harvested in the Roma and Wallumbilla districts during the autumn of this year. This plant is outstanding as a hay and grazing crop for the drier farming areas, as is indicated by its popularity on the Darling Downs and in the Maranoa. Lack of harvesting machinery and implements, such as the reaper and binder, or mower and rake, on many stock farms, is the retarding factor so far as the conservation of hay is concerned.

Despite the excellent growth of native grasses, dairy production declined considerably from April onwards, as dry, mature grass is unsuitable for milking cows. With the more extensive use of blue panic and Rhodes grass, the conservation of Sudan grass as hay and silage, and the more widespread utilisation of winter fodders, such as wheat and barley, it should be possible to carry on dairying in the drier country away from the coast right through the winter, even in the Maranoa. Many dairy farmers in those regions dry the cows off during the autumn, and may not milk again until the spring.

In recommending Sudan grass as a grazing crop, the risk of fatalities as a result of hydrocyanic acid poisoning must be kept in mind. This subject has been fully discussed in the *Queensland Agricultural Journal*, and, as mentioned therein, many farmers have utilised Sudan grass in all stages of growth as a grazing crop without ill effects. An effort should be made to procure pure seed, free from admixture with sorghum or Johnson grass hybrids. Full information regarding the cultivation of Sudan grass can be obtained from the Department of Agriculture and Stock, Brisbane.

Overripe Milk and Cream.

The only desirable change in milk or cream for cheese-making or butter-making is the production of lactic acid, which is derived from the breaking down of the milk sugar by the lactic acid bacteria. However, the development of too much acidity is not desired, as it causes difficulty in manufacturing choice quality cheese and butter. Setting overripe milk with rennet gives trouble in the subsequent stages of cheese-making. Excessive acidity in cream to be used for butter-making gives rise to neutraliser flavours in the butter and there is also the possibility of more serious faults developing in overripe cream, such as cheesy and curdy flavours.

The most important factor in the development of overripeness is undoubtedly holding the raw material at too high a temperature and where there is infrequent delivery to the factory this defect will yearly cause considerable loss of revenue to suppliers through failure to control the activities of the causal bacteria.

To overcome the effect of seasonal conditions much more could be attempted by progressive farmers than is done at present. The most favourable temperature range at which the proper changes take place in cream for butter-making is between 60 and 70 deg. Fahrenheit. The use of cooling devices, which are procurable for about £2, makes such temperatures attainable even in the hottest weather. The perusal of records kept by farmers who have installed such coolers has disclosed that even on the hottest days their cream was cooled after separation to within a few degrees of 70 deg. Fahrenheit. Furthermore, they have not had second grade cream since adopting the method.

A concrete water trough about 2 feet wide by about 8 inches deep at the southern end of the dairyhouse is another aid when filled to cooling and keeping cream cool; but the trough must be emptied and refilled regularly or it will become a menace.

Another way of preventing overripeness is to deliver the cream to the factory as frequently as possible. Also, do not separate cream to contain less than 38 per cent. butterfat between October and March, inclusive, as a cream of low butterfat test is prone to develop increased acidity in the summer months.

Variegated Thistle Poisonous to Stock.

On the Darling Downs recently, a dairy farmer reported the sudden death of three cows in his herd. Unfortunately, the carcases had been destroyed by burning, so it was impossible to conduct post-mortem examinations. A visit to the property disclosed that the evening preceding the mortalities, a quantity of variegated thistle had been cut, and on the following morning it was eaten by the affected cows. It had been expressly cut to provide feed, because of the dry times. Within a few hours, three head showed marked symptoms of wobbly gait and distress, and eventually they died. Animals in other paddocks were not affected.

Many plants are poisonous in certain stages of development. A warning is issued to beware of variegated thistle, and to refrain from cutting it as feed for hungry stock. This plant has been reported upon by New South Wales authorities as being extremely poisonous at times, and more particularly in respect of travelling and hungry stock.

Orchard Notes

JANUARY.

THE COASTAL DISTRICTS.

ALL orchards and plantations should be carrying a good cover crop—in the first place, to help to check erosion during the coming heavy rainy season; and secondly, to maintain the soil in good physical condition when cut down and turned under. This advice is especially applicable to citrus orchards and hillside banana plantations, which frequently suffer from severe losses of valuable top soil.

Pineapple plantations must be kept well worked to assist the main summer crop later on.

Keep pineapple plantations of all ages weed-free by shallow Dutch hoe cultivation.

Pineapple growers who have missed the spring planting will usually find it better to delay activities until the end of February. The idea is to wait until the main monsoonal rains have ceased. Then the ground will still be warm and moist; while there still remains a sufficiently long growing period to enable young plants to make a good development before the cold weather checks growth.

Bananas and pineapples may still be planted, though it is somewhat late for the former in the more southern parts of the State. Keep a good lookout for pests of all kinds, such as Maori on citrus trees, scale insects of all kinds, all leaf-eating insects, borers, and fungus pests generally, using the remedies recommended in Departmental publications. Bunchy Top in bananas will be most severe during February, March, and April in those districts in which it exists and growers should make regular patrols of plantations.

Fruit fly should receive special attention, and on no account should infested fruit of any kind be allowed to lie about on the ground to become the means of breeding this serious pest. If this is neglected, when the main mango crop in the South and the early-ripening citrus fruits are ready, there will be an army of flies waiting to destroy them,

Be very careful in handling and marketing of all kinds of fruit, as it soon spoils in hot weather, even when given the most careful treatment. Further, as during January, there is generally more or less of a glut of fresh fruit, only the best will meet with a ready sale at a satisfactory price.

Grapes are in full season, and in order that they may be sold to advantage they must be very carefully handled, graded, and packed, as their value depends very much on the condition in which they reach the market and open up for sale. Well-coloured fruit, with the bloom on and without a blemish, always sells well, whereas badly coloured, immature, or bruised fruit is hard to quit.

One of the greatest mistakes in marketing grapes is to send the fruit to market before it is properly ripe, and there is no better way to spoil its sale than to try and force it on the general public when it is sour and unfit to eat.

Bananas for sending to the Southern States require to be cut on the green side, but not when they are so immature as to be only partially filled. The fruit must be well filled but show no sign of ripening; it must be carefully graded and packed and the cases marked in accordance with the regulations under the Fruit Cases Acts and forwarded to its destination with as little delay as possible.

Pineapples should be packed when they are fully developed, which means that they contain sufficient sugar to enable the fruit to mature properly. Immature fruit must not be marketed, and if an attempt is made to do so the fruit is liable to seizure and the sender of the fruit to prosecution under the abovenamed regulations. Further, the fruit must be graded to size and the number of fruit contained in a case must be marked thereon. Immature fruit must not be sent. For canning, the fruit should be partly coloured; immature fruit is useless; and over-ripe fruit is just as bad. The former is deficient in colour and flavour and the latter is "winey" and of poor texture, so that it will not stand the necessary preparation and cooking.

Should there be a glut of bananas, growers are advised to try and convert any thoroughly ripe fruit into banana figs.

The fruit must be thoroughly ripe, so that it will peel easily, and it should be laid in a single layer on wooden trays and placed in the sun to dry. If the weather is settled, there is little trouble, but if there is any sign of rain the trays must be stacked till the weather is again fine, and the top of the stack protected from the rain. To facilitate drying, the fruit may be cut in half lenghtways. It should be dried till a small portion rubbed between the finger and thumb shows no sign of moisture. It can be placed in a suitable box to sweat for a few days, after which it can be dipped in boiling water to destroy any moth or insect eggs that may have been laid on it during the process of drying and sweating. It is then placed in the sun to dry off any moisture, and when quite dry it should be at once packed into boxes lined with clean white paper. It must be firmly packed, when, if it has been properly dried, it will keep a considerable time. It can be used in many ways, and forms an excellent substitute for raisins, sultanas, currants, or other dried fruits used in making fruit cakes and other comestibles. Banana figs will be found useful for home consumption, and it is possible that a trade may be built up that will absorb a quantity of fruit that would otherwise go to waste.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

JANUARY is a busy month in the Granite Belt, and orchardists are fully occupied gathering, packing, and marketing the crop of midseason fruits, consisting of plums of several kinds, peaches, nectarines, pears, and apples. The majority of these fruits are better keepers and carriers than those that ripen earlier in the season; at the same time, the period of usefulness of any particular fruit is very limited, and it must be marketed and disposed of with as little delay as possible.

With the great increase in production, owing to the large area of new orchards coming into bearing and the increasing yields of those orchards that have not come into full profit, there is not likely to be any market for immature or inferior fruit. There will be ample good fruit to fully supply the markets that are available and accessible. Much of the fruit will not carry far beyond the metropolitan market, but firm-fleshed plums, clingstone peaches, and good firm apples should stand the journey to the Central District, and, if they are very carefully selected, handled in a manner to prevent any bruising, and properly graded and packed, they should carry as far as Townsville. Growers must remember that, given a market fully supplied with fruit, only such fruit as reaches that market in first-class condition is likely to bring a price that will pay them; consequently the grower who takes the trouble to send nothing but perfect fruit; to grade it for size and colour, to pack it carefully and honestly, placing only one-sized fruit, of even quality and even colour, in a case and packing it so that it will carry without bruising, and, when opened up for sale, will show to the best advantage, is pretty certain of making good. On the other hand, the careless grower who sends inferior badly graded, or badly packed fruit is very likely to find when the returns for the sale of this fruit are to hand that after paying expenses there is little, if anything, left. The expense of marketing the fruit is practically the same in both cases.

Then why "spoil the ship for a ha'porth of tar" after you have gone to the expense of pruning, spraying, manuring, and cultivating your orchard? Why not try and get a maximum return for your labour by marketing your fruit properly? The packing of all kinds of fruit is a fairly simple matter, provided you will remember—

(1.) That the fruit must be fully developed, but yet quite firm when gathered.

(2.) That it must be handled like eggs, as a bruised fruit is a spoilt fruit, and, when packed with sound fruit, spoils them also.

(3.) That only one-sized fruit, of an even degree of ripeness and colour, must be packed in a case.

(4.) That the fruit must be so packed that it will not shift, for if it is loosely packed it will be so bruised when it reaches its destination that it will be of little value. At the same time, it must not be packed so tightly as to crush the fruit.

If these simple rules are borne in mind, growers will find that much of the blame they frequently attribute to the fruit merchants or middlemen is actually the result of their own lack of care. Fruit that opens up in the pink of condition sells itself, whereas any fruit that opens up indifferently is hard to sell on any except a bare market, and on a glutted market is either unsaleable or realises such a poor price that the grower is frequently out of pocket, and would have been better off had he not attempted to market it.

If spraying with arsenate of lead and systematic bandaging has been properly carried out, there will be comparatively few codlin moths to destroy the later ripening pip fruits; but if these essential operations have been neglected or carelessly carried out a number of moths will hatch out and the eggs laid by them will turn to larvæ that will do much damage, in some cases even more than that caused by the first broods that attack the fruit as soon as it is formed. Where there is any likelihood, therefore, of a late crop of moths, spraying with arsenate of lead must be continued if the late crop of pip fruits is to be kept free from this serious pest.

Fruit fly must be systematically fought, and on no account must any fly-infected fruit be allowed to lie about on the ground and breed this pest, to do further damage to the later ripening fruits.

Citrus orchards will need to be kept well cultivated in the drier and warmer parts of the State, and, where necessary, the trees should be irrigated. If scale insects are present, the trees should be either sprayed or, better still, treated with hydrocyanic acid gas.

Western grapes are in full season, and if they are to be sent long distances by rail then they are all the better to be cut some hours before they are packed, as this tends to wilt the stems and keep the berries from falling off in transit. The fruit must be perfectly dry when packed, and should be as cool as possible. It must be firmly packed, as a slack-packed case always carries badly and the fruit opens up in a more or less bruised condition.

THE BLENDING OF CREAM.

The great importance of the operation of blending cream is evidently not well understood by many farmers, judging by the condition in which much cream reaches the butter factories. Lack of proper attention to this vital matter is often the cause of undesirable fermentations, which detract from the bright, aromatic flavour desired in choice cream, and results in the consignment being graded down.

The practice of holding the cream from each separation in a separate utensil encourages the development of faults like staleness and over-ripeness in the portions which are kept longest on the farm, and the mixing of these portions with the other separations just before despatching to the factory gives a bulk cream of inferior flavour. Adding the cream straight from the separator, without in any way reducing the animal heat, to a partly-filled can of cream from a previous separation is another practice which merits the severest condemnation.

The correct procedure to follow is to mix each batch with the bulk after the heat has been reduced, which usually takes about an hour, unless cooling devices are used, when the different portions can be mixed immediately. It is much easier to prevent off flavours from developing by keeping the cream in larger quantities than by retaining each separation in a separate container.

Some farmers consider that by keeping each separation apart the risk of getting second-grade cream is minimised or, at any rate, that only part of the supply is likely to be graded low. However, modern methods have demonstrated very definitely that correct blending of cream, by ensuring an even souring, helps to achieve choice quality.

Stirring of the cream at regular intervals throughout the day may be regarded as an essential point in the correct blending of cream. It assists to obtain even ripening and even consistency. Finally, it should always be the rule to deliver to the factory as frequently as transport arrangements will permit, for the longer that cream is kept on the farm the more difficult control of ripening becomes.

Farm Notes

JANUARY.

FIELD.—The main business of the field during this month will be ploughing and preparing the land for the potato and other future crops, and keeping all growing crops clean. Great care must be exercised in the selection of seed potatoes to ensure their not being affected by the Irish blight. Never allow weeds to seed. This may be unavoidable in the event of long-continued heavy rains, but every effort should be made to prevent the weeds coming to maturity. A little maize may still be sown for a late crop. Sow sorghums, *Setaria* Sp. (panicum), teosinte, and cowpeas. In some very early localities, potatoes may be sown, but there is considerable risk in sowing during this month, and it may be looked upon merely as an experiment. Plant potatoes whole. Early-sown cotton will be in bloom.

On coastal and intercoastal scrub districts, where recently burnt-off scrub lands are ready for the reception of seed of summer-growing grasses, sowing may commence as soon as suitable weather is experienced. Much disappointment may be saved, and subsequent expenditure obviated, by ensuring that only good germinable grass seed is sown, of kinds and in quantities to suit local conditions, the circumstances being kept in mind that a good stand of grass is the principal factor in keeping down weeds and undergrowth.

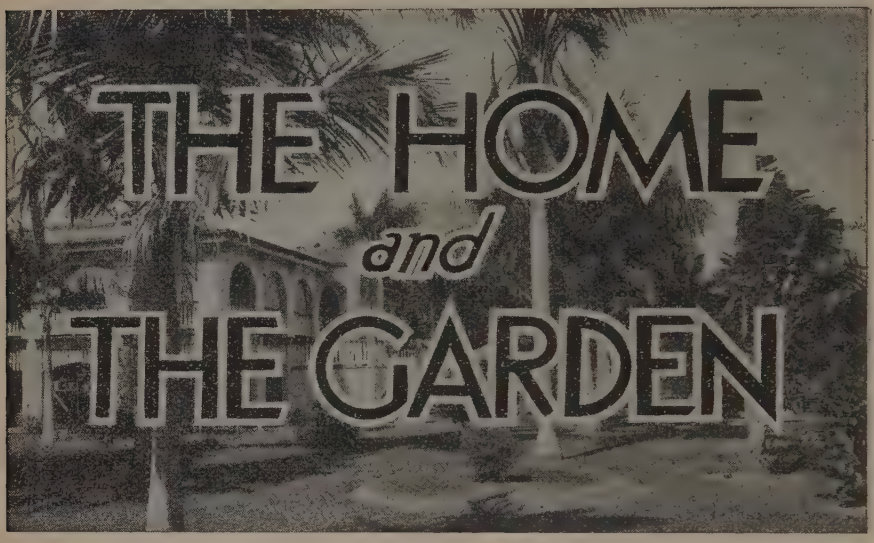
In all districts where wheat, barley, oats, canary seed, and similar crops have recently been harvested, the practice of breaking up the surface soil on the cropped areas should invariably be adopted. Soil put into fit condition in this way will "trap" moisture and admit of the rains percolating into the subsoil, where the moisture necessary for the production of a succeeding crop can be held, provided attention is given to the maintenance of a surface mulch, and to the removal, by regular cultivation, of volunteer growths of all kinds. If not already seen to, all harvesting machinery should be put under cover, overhauled, and the woodwork painted where required.

Where maize and all summer-growing "hoed" crops are not too far advanced for the purpose, they should be kept in a well-cultivated condition with the horse hoe. Young maize and sorghum crops will derive much benefit by harrowing them, in the same direction as the rows are running, using light lever harrows with the tines set back at an angle to obviate dragging out of plants, but the work should not be done in the heat of the day.

Quick-maturing varieties of maize and sorghum may still be sown in the early part of the month in coastal areas where early frosts are not expected.

Succession sowings may be made of a number of quick-growing summer fodder crops—Sudan grass, Japanese and French millet, white panicum, and liberty millet (panicum). In favourable situations, both "grain" and "saccharine" sorghums may still be grown; also maize, for fodder purposes.

Fodder conservation should be the aim of everyone who derives a living from stock, particularly the dairyman; the present is an important period to plan cropping arrangements. Exclusive of the main crops for feeding-off (when fodder is suitable for this purpose), ample provision should be made for ensilage crops to be conserved in silo or stack. As natural and summer-growing artificial grasses may be expected to lose some of their succulence in autumn, and more of it in winter and early spring, the cropping "layout" to provide a continuity of succulent green fodder throughout the season calls for thorough and deep cultivation and the building up of the fertility and moisture-holding capacity of the soil. Planter's friend (sorghum) may be sown as a broadcast crop at the latter end of the month for cutting and feeding to cattle in the autumn and early winter. Strips of land should be prepared also for a succession sowing about the second week in February, and for winter-growing fodder crops.



OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

A WISE MOTHER.

HOW fortunate are the children of a good mother! Of her more than of anyone else it may be said that her work lives after her. Very seldom does she discuss her methods in print. We therefore do not hesitate to reprint the following article.*

Freedom and Discipline.

"I am a firm believer in discipline for baby from the earliest cradle days. By that I mean that baby must be taught automatic obedience and must learn to respond to a regular rhythm, and not find that, by the power of the lungs, he can bring himself extra attention or other delights. But, while discipline is one side of the picture (and a very important side), and while it is my belief that if obedience has not been taught by the second birthday it will be very, very hard for it ever to be taught, yet I would plead with mothers to give their children the maximum amount of freedom possible.

"Children are not small replicas of their mothers, nor are they miniature adults, and we must always beware of seeking to regulate their lives from an adult standpoint. Nothing to so likely to blight and spoil a budding personality as a too rigid and unimaginative authority.

"Take the question of freedom in physical action. Almost incessant movement on the part of the pre-school child is both right and

* From a New Zealand paper, which reprinted it from the "Women's Pictorial" eight years ago. The name of the writer was not given.

necessary. The law of growth and co-ordination of the muscles depends almost entirely on such movement, and every natural activity and impulse gives practice to the muscular and sensory systems, enabling them to develop to the full.

"Any training which cuts across this natural law is both cruel and foolish. If you cannot have both flowers and children in your garden, sacrifice the flowers.

Legitimate Outlets.

"When legitimate outlets are provided for this activity, there will be no need for endless strings of 'Don'ts' from morning to night, which are so wearing to both mother and child. The best outlay a mother can make is to erect in some way an outside shelter or veranda, to provide outdoor tables, chairs, and sleeping places, and to install a large sand pile, while a see-saw and a box of wooden bricks are excellent outdoor equipment. With such simple arrangement the toddlers will be happy, healthy, and content, and the garden a far more radiant place than any number of flowers could ever make it.

"Even when activity is directed into some dangerous channel, it should not be sternly repressed, but merely redirected into an equally delightful but harmless one. All commands should be, as far as possible, positive, not negative, and with a little imagination, many of the child's natural desires can be legitimately satisfied. For instance, all children love playing with scissors, and there is no reason why round-topped, bluntish ones should not be provided, and the child carefully taught how to use them.

"With regard to freedom of choice of action, experience shows that it is usually more kind to the child to allow this, but rarely. A child has so little experience, and often takes life so seriously, that he will exhaust his supply of nervous energy in trying to decide for himself which of two pleasures he would choose.

"To plan the day so that there is no hesitation will make for restfulness.

"The wise mother will refrain from speaking until any plan that is in her mind is quite matured and settled, while undoubtedly the fewer changes which are made in the everyday routine the better it is for character and content. We should find such a routine boring, but a small child delights in law and order, and in frequent repetition—as any nursery story-teller can witness!

Example Counts.

"When we come to the question of character and morals, the crux of the whole situation is the atmosphere which we ourselves are creating. Baby's sharp eyes are ever watching and striving to imitate the beloved adult, and he can have no experience of any moral tone except that which is in his own home. Hence the importance of self-control in home life, and of being scrupulously careful in the choice of any deputy who is much with the child. Sometimes daddy, tired from the office, is a stumbling block to his little one, for it is useless to speak of the value of politeness, chivalry, cheerfulness, and so on if the man of the house lolls at table or permits himself to be grumpy or disagreeable. One of the most important of childish instincts is the longing 'to be big,' and if virtues which are instilled into him are connected solely with the

nursery, he will, sooner or later, desire to show his emancipation by practising the opposite. If virtues, however, are the adult things, and wilfulness, rebellion, untidiness, and so on, signs of babyhood, then we have a powerful incentive to help him to acquire the former and outgrow the latter."

COMMON DANGERS ON REEF AND SHORE.

IT is especially desirable that children and adults should be warned of the dangers awaiting the unwary on sandy beaches or on the reefs along the seashore, for with the coming of the warmer season and the holidays of Christmas and New Year the beaches and coastal waters will be thronged with many thousands of people to whom such a warning might come very opportunely.

Some of these dangers are listed as follows:—

The Portuguese Man-of-War.

Blue-tinted sausage-balloon often found in the water or on the beach near the edge. It has several long blue strands which may sting a person so severely that paralysis and even death may follow.

Cure.—Apply sal volatile as quickly as possible to the affected parts. Sal volatile may be used also for jelly-fish stings.

Cone-Shell (Geographus).

Usually found under large boulders. It is a pretty shell, which should *never* be handled except with tweezers. It was one of these shells that caused the death of a man some time ago.

Cone-Shell (Textile).

This textile cone is the commoner of the two cones and is considered not quite so deadly.

Stonefish.

Sluggish in habit. When danger threatens it raises its thirteen dorsal spines. Usually hidden among weed and sand. Causes excruciating pain, relieved only by morphia, and lasting in effect for as long as six months. Sometimes found in Moreton Bay.

Cure.—Relief may be obtained by applying heated onion. Medical aid should be summoned immediately.

Cutshell (or Razor Shell).

Usually so embedded in the muddy sand as to have its sharp razor edges just level with the surface. If a wound has been inflicted by a razor shell (or an oyster), care should be taken to clean the wound of all pieces of shell and then cover with collodion, which will form a seal over the injured part.

General Advice.

Never go wading unless stout shoes with thick leather soles are worn; sandshoes are not a really suitable covering.

Never touch any strange object in the water or on the beach.

IN THE FARM KITCHEN.

USES OF MACARONI.

Macaroni provides a welcome change from the usual meat dishes, and can be combined with other foods to form an appetising course.

To Boil Macaroni.

Place the macaroni in a saucepan containing enough boiling water to cover it well. Boil uncovered for about twenty minutes. Turn into a colander. Run the cold tap on it for a second or so, then drain again, and use as required.

Macaroni and Cheese Scallops.

Take 4 oz. macaroni, ¼ pint milk, 2 oz. cooked ham, 2 oz. grated cheese, 2 eggs, 1½ oz. butter, stale breadcrumbs, pepper, and salt to taste.

Boil macaroni, drain well, and chop. Stir in half of the butter, melted cheese, chopped ham, beaten eggs, milk, pepper and salt to taste. Butter as many scallop shells as are required. Sprinkle them with stale breadcrumbs. Fill with the mixture. Sprinkle lightly with stale breadcrumbs. Place small pieces of the remaining butter on top, and bake till crisp and brown.

Tomatoes with Macaroni Stuffing.

Take 6 large tomatoes, 4 oz. cooked macaroni, 4 large tablespoonfuls grated cheese, 1 egg, 1 teaspoonful chopped parsley, breadcrumbs, ¾ cupful tinned tomato soup, 2 tablespoonfuls butter, pepper, salt to taste.

Put the soup into a saucepan. Cut up and add macaroni. Bring to boil, cook for a few minutes, then cool and drain. Add parsley, pepper, and salt to taste. Beat the egg lightly, add cheese, mix well, and stir into the macaroni. Remove a slice from blossom end of tomatoes, and carefully scoop out pulp. Fill tomatoes with mixture, cover with a layer of breadcrumbs. Dab with tiny pats of butter. Bake till brown.

Spinach and Macaroni.

Take ½ lb. macaroni, 2 tablespoonfuls melted butter, 2 tablespoonfuls meat gravy, grated nutmeg, 2 bunches English spinach, 1 oz. flour, 1 gill white sauce, pepper and salt.

Cook macaroni in boiling water till tender. Meanwhile, boil the spinach. Drain, chop, and sieve. Return spinach to pan. Season to taste with salt, pepper, and grated nutmeg, if liked. Stir flour into the melted butter, then add gravy. Bring to the boil and add spinach. Stir hot white sauce into drained macaroni, and place in a border round a hot fireproof dish. Pack the spinach in the centre. Garnish spinach with chopped macaroni.

Macaroni Eggs.

Take 2 eggs , 1 onion, ½ lb. tomatoes, ½ oz. butter, ½ gill water, sprig parsley and thyme, ½ clove garlic, 1 teaspoonful cornflour, 2 oz. macaroni.

Peel and mince the onion, cook it for a few minutes in the butter, but do not let it brown. Add the sliced tomatoes, also the water, herbs, and garlic, and cook them gently till tender. When ready, remove the herbs and garlic, and rub sauce through a sieve, then thicken it with the cornflour smoothed in a little cold water, and add seasoning to taste. Meanwhile, break up the macaroni, leaving two long pieces. Wash it and cook it in boiling water with salt, drain it when tender, and mix with half the tomato sauce. Turn this into a fireproof dish, make two hollows and break an egg into each, season them well, pour the remainder of the sauce carefully over them, and put the dish in the oven long enough to cook the eggs. Garnish the dish with the two long pieces of macaroni.

Baked Macaroni and Tomatoes.

Take ½ lb. macaroni, 2 lb. tin tomatoes, 1 oz. butter, 3 tablespoonfuls breadcrumbs, 1 small onion, pepper, and salt.

Arrange boiled and drained macaroni in a greased, fireproof baking dish, season to taste with salt and pepper, and sprinkle with half the chopped onion. Cover with the tomatoes, the remainder of the onion, season with pepper and salt, then cover with the crumbs. Place tiny pats of butter on top. Bake in a moderate oven on the top shelf for half an hour.

Macaroni and Oysters.

Take 2 oz. macaroni, ½ oz. butter, ½ oz. flour, 1 gill milk, 1 dozen oysters, juice ½ lemon, salt and cayenne.

Break the macaroni into pieces an inch long, and boil till tender in fast-boiling water, to which a little salt has been added; then strain, melt the butter in a saucepan, add the flour, and mix well. Stir in the milk with the pan off the gas. Replace over the heat, and stir till it boils. Season with lemon juice, salt, and cayenne. Remove the beards from the oysters, and put the oyster liquor into the sauce with the macaroni. Cut six of the oysters in half, and add them to the macaroni mixture. Pour into a fireproof dish, and lightly brown in a hot over for five minutes. Put six whole oysters on top, and serve.

Italian Macaroni Pie.

Take ½ lb. to ¾ lb. cold cooked beef or mutton, ½ onion, 3 firm, ripe tomatoes, ¼ lb macaroni, salt, pepper, nutmeg, a little sauce or stock, breadcrumbs, cheese.

Cut the meat into thin slices, peel and slice thinly half an onion, and the tomatoes. Boil the macaroni till tender in slightly salted water. Drain and cool the macaroni, and cut it up rather small. Line a buttered baking dish with macaroni, and range the meat, onion, and tomato slices on the baking dish. Season with salt, pepper, and nutmeg; pour over a little sauce or stock, and cover top with macaroni. Sprinkle over some breadcrumbs and grated cheese, and bake for about half an hour in a hot oven.

PUMPKIN PIE.

Here are three ways of making pumpkin pie:—

1. 1½ grammas or a very dry, ordinary pumpkin (steamed); ¾ cup sugar; juice of two lemons; ½ packet of spice; ½ lb. currants.

When the pumpkin is cold, mash it well. Add sugar, lemon, juice, spice, and currants. Cover with a flaky crust and bake till golden brown.

2. 1 large gramma (steamed); ¾ cup sugar; juice of 1 lemon; juice of three passionfruit; an ounce of butter.

Mash the pumpkin with butter and sugar. Add lemon and passionfruit juices. Cover with a good short crust. Bake until golden brown. Serve with whipped and sweetened cream.

3. One large cup mashed, cooked pumpkin; one cup hot milk, ¼ teaspoon nutmeg; ½ teaspoon cinnamon; ½ teaspoon ginger, ½ cup brown sugar; one slightly beaten egg.

Mix all together. Have ready two pieces of good pastry. Lay one on round pie-dish. Spread mixture evenly, cover with second piece of pastry, mark for slicing, brush with white of egg, sprinkle with sugar, and bake about half an hour in a moderate oven. Serve hot, with custard or cream.

FACTS ABOUT THE PAPAW.

The papaw tree takes a prominent place among the many tropical fruits that thrive in Queensland. The papaw originally came from Central America and is known there by the natives as the "papaya" or "mamai" (father and mother) tree, according to the sex of the plant. Introduced many years ago, the papaw gradually became acclimatised until it found conditions so congenial that it now thrives on the coastal areas of Queensland.

Papaw trees grow from seeds. The tree is a small one seldom exceeding twenty feet in height, is of spongy texture and is usually hollow in the middle. It resembles a bamboo in this respect. It is practically branchless, and is surmounted by a crown of large palmate leaves, at the base of which fruit is produced. Of late years some growers have adopted the practice of stopping the growth of the main stem and forcing the tree to throw two or more branches. By this means, the tree bears a far greater quantity of fruit close to the ground than is the case if it is allowed to develop naturally.

The trees are sexed. The male tree flowers profusely, bearing flowers at the end of long stems which hang down and suspend vertically any fruit if formed.

As the fruit borne by male trees is small and of no commercial value, the trees are usually cut out as soon as the sex can be determined, a few only being left for the purposes of fertilization of the seeds in the fruit of the female trees.

The female tree bears flowers at the base of the stem of each leaf and a profusion of fruit forms close to the stem. The fruit are often so thick on the stem of the tree that many of the papaws are crushed as they develop, and ripen in a misshapen condition.

The papaw tree, being of tropical origin, is particularly liable to damage from frost, and must be grown in positions sheltered from heavy winds and frost.

Seeds are planted in beds in the spring and early summer, and the small seedlings transplanted to the field when from six to twelve inches in height. In order to make full allowance for the cutting out of the male trees, two and at times even three seedlings are planted to each stool, but of these not more than one tree is allowed to bear fruit. Trees are spaced from eight to ten feet square. The young plant develops rapidly and, given suitable growing conditions, the female will at times commence to bear fruit within two feet of the ground. Particularly vigorous trees will at the one time have from four to six feet of the stem literally covered with fruit. Trees will bear in approximately twelve months, and although their commercial bearing life is short, seldom exceeding four years, the actual weight of fruit produced per tree is high. The fruit ripens from the base upwards, and no part of the stem ever bears more than one crop. As the tree ages the fruit is developed higher and higher from the ground, and it is a common sight to see branchless trees so high that ladders must be used for picking.

The crop usually commences to mature in April, and continues heavily until Christmas, with light supplies available through January. The papaw has thick yellow flesh with a small cavity in the centre, which usually contains a number of black seeds.

The skin of the papaw is very thin and particularly delicate when the fruit is fully ripe. The thinness of the skin makes it peculiarly susceptible to outside influences, and accounts for so many of the ripe papaws showing blemishes. These, however, do not detract from the eating quality of the fruit.

Gradually the health-giving properties of the papaw are receiving wider recognition, and the acreage under papaws is increasing. The papaw is grown throughout coastal Queensland.

As a table fruit the papaw is delicious and wholesome. Some palates may not appreciate the flavour at first, but the papaw habit is well worth acquiring in such cases. The addition of a little orange or lemon juice or passion fruit greatly improves the flavour.. For salads, papaws are especially valuable. The size of fruit varies on each tree, but most fruit marketed will provide from 1 to 5 lb. of succulent flesh which, by the addition of sliced oranges and pineapple, quickly makes a delightful salad, and one that will allow generous helpings. Papaws are in season from April to December. Every fruit shop in Queensland sells papaws, and cafes serve them daily during the season. Iced papaw is very popular. Papaws should not to be eaten until the flesh is soft.

The papaw is used in various forms:—

(*a*) In its ripe state as a breakfast fruit, for which purpose it is cut lengthwise into individual portions, and the seeds are removed. It is flavoured to suit the taste by the addition of lemon or orange juice and sugar—or with sugar only.

(*b*) As a dessert fruit, when it is sliced and eaten with sugar and crushed ice, or diced and incorporated with other fruits as a fruit salad.

(*c*) As a salad combined with lettuce or in mayonnaise; or served with green celery and onions.

(*d*) The green fruit may be boiled or baked and served as a vegetable.

(*e*) As a crystallised fruit, and it is sometimes made into pickles, marmalade, jelly, pie, jam, ice cream, and sherbet.

(*f*) As the main constituent of the following commercial lines: Tropical Fruit Salad and Papaw Chutney.

Nearly all parts of the papaw have some medicinal value. The most important medicinal properties are said to be found in the milky juice which occurs most abundantly in the green fruit. These properties of the juice are due to the active

principle called "papain," which has been long recognised as of considerable value in dyspepsia and kindred ailments. Its digestive action is undoubted, and it is a not uncommon practice to rub a slice of green juicy papaw on tough meat to make it tender. Another practice is to wrap the meat in crushed papaw leaves over-night preparatory to cooking it.

The papaw is a valuable aid to digestion, and many sufferers from dyspepsia have obtained relief by eating this fruit. Papaw juice contains papain, a powerful digestive ferment, which is often used instead of pepsin. For dysentery the ripe fruit is a sovereign remedy. The seeds have the flavour of watercress, and are an efficient vermifuge.

The late Lord Harris, who visited the West Indies with a team of English cricketers a few years ago, was a sufferer from digestive troubles. Such was the relief that he obtained from the eating of papaws, that he subsequently wrote in a local journal, urging that greater attention should be paid to the medicinal value of the papaw, and stressing his view that the importance of this wonderful fruit should be far more widely recognised.

In a recent report of the proceedings of the Agricultural Society of Trinidad, a contributor of a paper on the papaw said: "I have no greater authority than myself who am a constant sufferer of stomach troubles for which medical science has proved to be of very little use. Persuaded by a friend, I am now making use of the papaw in all recognised forms together with a tonic bearing the following recipe:— 'To a bottle of wine use about two green thinly skinned grated papaws, allow the composition to soak for a period of four days, after which it is strained and then used by taking a wineglass full before meals.' I am, indeed, gratified with the results."

Papaws contain no sucrose, but contain lævulose, which is specially suitable for diabetics.

HOUSING COCKERELS.

The housing of a large flock of cockerels, which are being reared either for stud or for table purposes, causes some concern, owing to the number which are injured through fighting. Fighting is more prevalent among light breeds, such as white leghorns, than among heavy breeds, such as australorps.

The rearing of a large number of cockerels in one unit could be arranged to great advantage by the provision of a special house, rather than making use of the usual type of fowlhouse. Cockerels of the same age should be placed in the same unit. The type of house recommended is one in which the walls do not reach the ground, thereby eliminating corners. For efficiency, economy, and simplicity of construction, a building of the gable-end type should meet requirements. The size, naturally, will depend on the number of birds to be accommodated. A building 12 feet long by 8 feet wide will accommodate, as a maximum, 100 white leghorns or 80 australorps. It will be noticed that, approximately, 1 square foot of floor space is allowed each bird. It is essential, however, that hens should be provided with double that area under the same system. Such a small floor space allowance is practicable, because the cockerels only occupy the house for a short period.

In the construction of such a building, the four corner posts may be 3 feet, and the two centre posts 7 feet high. By using 8-feet iron for the roof, it would extend to within 2 feet of the ground. The gable-end should face to a point between north and east. This will permit of the front being left uncovered, while the rear or westerly end should be covered with iron to within 2 feet of the ground. Perches are the only fittings necessary. These should be all on the same level, and 3 feet above the floor, run lengthwise, and spaced 2 feet apart. Such spacing will obviate fighting on the perches.

It is essential for a building of this type to be erected in the centre of a large netted run, or a distance from other buildings if the birds are to be reared on free range. In addition, it is advisable to erect a number of perches in different parts of the run. Such perches should be 3 feet high and situated away from boundary fences.

The advantages of this system of handling cockerels are that there are no corners or walls in the building, and on being chased the bird can escape easily by getting on a perch. An old cock bird placed in the pen, before the cockerels are three months of age, will materially assist in preventing the young birds fighting.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF OCTOBER IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Oct.	No. of Years' Records.	Oct., 1936.	Oct., 1935.		Oct.	No. of Years' Records.	Oct., 1936.	Oct., 1935.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	0·95	35	0·71	1·75	Clermont	1·33	65	0·32	1·04
Cairns	2·17	54	0·16	5·47	Gindie	1·41	37	Nil	1·41
Cardwell	2·08	64	0·18	2·99	Springsure	1·66	67	0·32	2·14
Cooktown	1·05	60	0·15	0·77					
Herberton	0·99	50	0·87	1·46					
Ingham	1·94	44	0·05	1·73					
Innisfail	3·33	55	0·19	9·94					
Mossman Mill ..	3·15	23	0·11	5·55	*Darling Downs.*				
Townsville	1·35	65	Nil	0·19					
Central Coast.					Dalby	2·06	66	0·50	1·72
					Emu Vale	2·20	40	0·53	2·17
					Hermitage	1·92	30	..	2·15
Ayr	0·94	49	Nil	0·08	Jimbour	1·90	48	0·75	2·32
Bowen	1·02	65	Nil	0·05	Miles	2·05	51	0·28	2·34
Charters Towers ..	0·73	54	3·0	1·53	Stanthorpe	2·56	63	1·73	1·89
Mackay	1·71	65	2·09	2·53	Toowoomba ..	2·58	64	0·25	3·89
Proserpine	1·65	33	0·15	0·12	Warwick	2·32	71	0·47	2·91
St. Lawrence ..	1·79	65	0·56	2·73					
South Coast.									
Biggenden	2·45	37	0·61	3·44	*Maranoa.*				
Bundaberg	2·11	53	0·93	1·40					
Brisbane	2·57	84	0·16	4·93	Roma	1·78	62	0·36	2·72
Caboolture	2·54	49	0·51	4·18					
Childers	2·73	41	1·32	3·19					
Crohamhurst	3·31	43	1·53	4·92					
Esk	2·54	49	0·22	3·61					
Gayndah	2·41	65	1·62	2·20					
Gympie	2·72	66	0·92	3·34	*State Farms, &c.*				
Kilkivan	2·62	57	2·34	1·88					
Maryborough ..	2·78	65	1·10	1·94	Bungeworgoral ..	1·50	22	Nil	..
Nambour	3·12	40	1·05	5·64	Gatton College ..	2·01	37	0·15	2·81
Nanango	2·28	54	0·72	4·24	Kairi	1·02	22	..	..
Rockhampton ..	1·79	65	0·86	0·74	Mackay Sugar Experiment Station	1·44	39	2·47	2·62
Woodford	2·58	49	0·42	4·60					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—OCTOBER, 1936.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Means Atmospheric Pressure at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	29·91	85	72	91	30	61	16	15	1
Herberton	..	83	57	91	13	49	14	87	5
Rockhampton	29·98	90	66	101	27	57	1	86	4
Brisbane	30·00	83	63	99	28	56	1	16	4
Darling Downs.									
Dalby	29·97	88	56	99	13	47	14, 20	50	3
Stanthorpe	..	79	47	86	18	36	31	73	5
Toowoomba	..	82	53	92	18	42	14	25	3
Mid-Interior.									
Georgetown	29·92	97	67	103	11	58	3	112	3
Longreach	29·94	95	63	102	17, 18, 27	53	14	18	3
Mitchell	29·96	89	53	99	18	46	13, 14, 15, 31	25	4
Western									
Burketown	29·92	93	70	102	21	63	14	Nil	..
Boulia	29·94	95	65	105	17	57	1	6	1
Thargomindah	29·95	87	59	102	8	50	12	60	1

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	December, 1936.		January, 1937.		Dec., 1936.	Jan., 1937.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	p.m.
1	4·49	6·31	5·0	6·50	9·10	9·32
2	4·49	6·32	5·1	6·50	9·54	10·21
3	4·49	6·33	5·2	6·50	10·35	10·45
4	4·50	6·34	5·3	6·51	11·6	11·16
5	4·50	6·35	5·4	6·51	11·42	11·51
6	4·50	6·36	5·5	6·51	..	..
					a.m.	a.m.
7	4·50	6·37	5·6	6·52	12·15	12·27
8	4·50	6·38	5·7	6·52	12·46	1·2
9	4·51	6·38	5·7	6·52	1·17	1·47
10	4·51	6·39	5·8	6·52	1·49	2·35
11	4·51	6·39	5·9	6·51	2·29	3·28
12	4·51	6·40	5·9	6·51	3·8	4·24
13	4·52	6·40	5·10	6·51	3·53	5·28
14	4·52	6·41	5·10	6·51	4·43	6·21
15	4·52	6·41	5·11	6·51	5·37	7·21
16	4·52	6·42	5·12	6·50	6·32	8·22
17	4·53	6·42	5·13	6·50	7·32	9·21
18	4·53	6·43	5·14	6·50	8·30	10·32
19	4·53	6·43	5·14	6·50	9·30	11·26
20	4·54	6·44	5·15	6·50	10·29	12·29
21	4·54	6·44	5·16	6·49	11·26	1·35
					p.m.	
22	4·55	6·45	5·17	6·49	12·28	2·40
23	4·55	6·45	5·18	6·49	1·32	3·42
24	4·56	6·46	5·19	6·49	2·38	4·40
25	4·56	6·46	5·19	6·48	3·48	5·34
26	4·57	6·47	5·20	6·48	4·54	6·17
27	4·58	6·48	5·21	6·48	5·55	6·59
28	4·58	6·48	5·22	6·48	6·55	7·36
29	4·59	6·49	5·23	6·47	7·44	8·10
30	4·59	6·49	5·24	6·47	8·27	8·44
31	5·0	6·50	5·25	6·47	9.7	9·18

Phases of the Moon, Occultations, &c.

6 Dec.	☽ Last Quarter	4 20	a.m.
14 „	● New Moon	9 25	a.m.
21 „	☾ First Quarter	9 30	p.m.
28 „	○ Full Moon	2 0	p.m.

Apogee, 10th December, at 6.6 a.m.
Perigee, 26th December, at 6.36 a.m.

On the 22nd, the day of the Australian summer solstice, the Sun will reach its furthest distance, 23½ degrees south of the points due east and due west, and it will be found useful to note these points carefully on the horizon. In all places 23½ degrees south of the celestial equator the Sun will be directly overhead at noon, and a telegraph-pole will cast no shadow.

On the 27th Jupiter will rise and set with the Sun, and be lost to the evening sky. Observers may remember the interesting sight afforded when, in April last, the great, wonderfully luminous planet had risen above the eastern horizon and the curves of Scorpio stretched out above it. Watching the planets rising and setting night after night with this notable constellation (the result of the Earth's rotation), many would at the same time take note of its own proper motion by its increasing distance eastward from Alpha Scorpii (Antares) until it crossed the border of Sagittarius about the middle of November.

On the 29th Mercury will reach its greatest elongation, 20 degrees eastward of the Sun, and on that date remain above the horizon for nearly an hour and a-half.

Mercury rises at 5.13 a.m., 24 minutes after the Sun, and sets at 7.5 p.m., 34 minutes after it, on the 1st; on the 15th it rises at 5.51 a.m., 59 minutes after the Sun, and sets at 7.48 p.m., 1 hour 7 minutes after it.

Venus rises at 7.32 a.m., 2 hours 43 minutes after the Sun, and sets at 9.24 p.m., 2 hours 53 minutes after it, on the 1st; on the 15th it rises at 7.55 a.m., 3 hours 3 minutes after the Sun, and sets at 9.36 p.m., 2 hours 55 minutes after it.

Mars rises at 1.39 a.m., 3 hours 10 minutes before the Sun, and sets at 2.1 p.m., 4 hours 30 minutes before it, on the 1st; on the 15th it rises at 1.8 a.m., 3 hours 44 minutes before the Sun, and sets at 1.43 p.m., 5 hours 1 minute before it.

Saturn rises at 12.2 p.m. and sets at 12.44 a.m. on the 1st; on the 15th it rises at 11.11 a.m., and sets at 11.50 p.m.

Although the Southern Cross will be absent from the evening sky, Orion, the Hyades and Pleiades, Sirius and Canopus, with Jupiter and Venus, will form a most wonderful picture at Christmas time.

4 Jan.	☽ Last Quarter	12 22	a.m.
13 „	● New Moon	2 47	a.m.
20 „	☾ First Quarter	6 2	a.m.
27 „	○ Full Moon	3 15	a.m.

Apogee, 7th January, at 1.0 a.m.
Perigee, 22nd January, at 1.0 p.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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